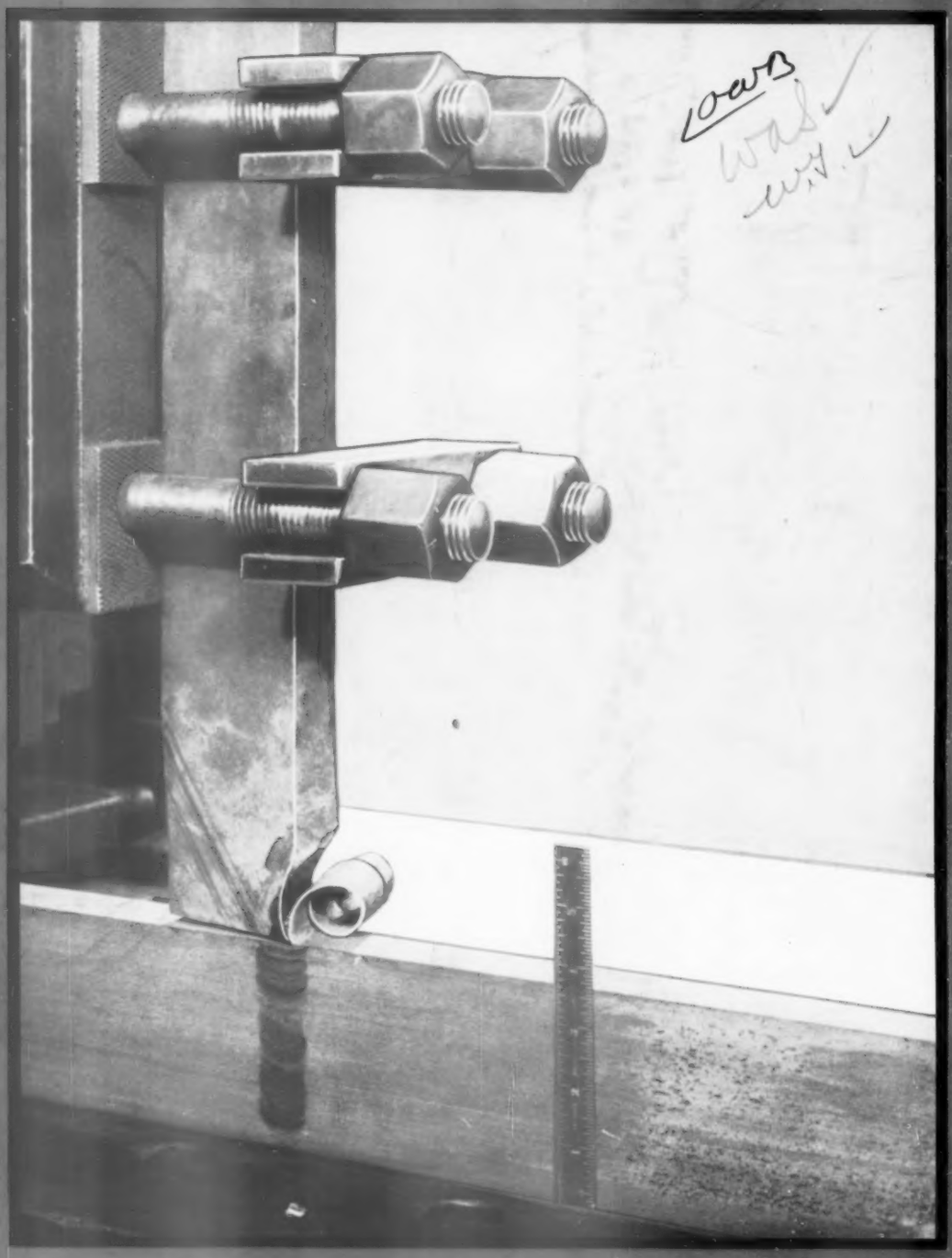
The Welding Engineer

Reg. U. S. Pat. Office



Qualifying the Welding Wire (*See Page 5*)

March
1932

PREMIER
TESTED
Welding Wire

Welds of Maximum Strength

You can be sure of maximum strength and satisfaction when you use Premier Tested Welding Wire—both electric and gas. No guesswork with this wire for each bundle is shop tested for uniformity—for perfect fusion—for impurities—for general efficiency before it gets into your hands. Thus, remarkable service records are the rewards of those who specify Premier. There's a type for every purpose and each length is plainly marked for grade. Write us about your welding problems—no obligation.

1831 MORE THAN 100 YEARS of PROGRESS IN WIRE MAKING **1932**

AMERICAN STEEL & WIRE COMPANY

208 South LaSalle Street, Chicago — SUBSIDIARY OF UNITED STATES STEEL CORPORATION — And All Principal Cities

Pacific Coast Distributors. Columbia Steel Company, Russ Building, San Francisco — *Export Distributors:* United States Steel Products Company, New York

The Welding Engineer

Founded by L. B. Mackenzie, 1916

With Which is Combined ACETYLENE JOURNAL

Volume 17 | March, 1932 | Number 3

THE WELDING ENGINEER
PUBLISHING CO.

608 S. Dearborn St., Chicago, Ill.

Telephone WEBster 7134

G. H. Mackenzie.....President and Treasurer
H. S. Card.....Secretary

H. S. Card.....Editor
M. S. Hendricks.....Managing Editor

Eastern Office—222 American Circle Bldg., New York. T. E. DePew, Eastern Manager. Telephone, Columbus 7843

AUTHORIZED REPRESENTATIVES

CLEVELAND, OHIO—R. K. Randall, 2261 E. 14th St.

DENVER, COLO.—A. G. Odell, Public Opportunity School.

GREAT BRITAIN—Capt. D. Richardson, 26 Winterbrook Road, Herne Hill, London.

AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand.

SOUTH AFRICA—J. W. Arnison, 35a Victoria Ave., Benoni, Transvaal, South Africa.

Published on the 15th of each month. Subscription payable in advance and postage free. United States and possessions, $3 a year; Foreign Countries, $4 a year; Canada, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 30 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

Last advertising forms close at 8:00 a. m. on the 12th. To show proof for correction copy must be received at an earlier date and allowances should be made for delay to mails. All copy should be in by the 12th of the month at the latest.

The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

MEMBER AUDIT BUREAU OF CIRCULATIONS

Table of Contents

THE MONTHLY SYMPOSIUM

Production and Fabrication 21

Special Steels 23

Weld Design 24

New Applications 25

Qualifying the Welding Wire 27
By G. W. Plinke

Big Contracts Can Be Made Bigger 32
By Elmer H. Smith

Resistance Welding Transformers 35
By P. W. Fassler

Methods of Controlling Arc Blow 40
By R. W. Holt

Hints for the Welder 47

Editorial 19

Fatigue Strength and Strain Relief 38
By Chas. H. Jennings

Economies Obtainable by Welding in Structural Steel Fabrication 43
By Alexander L. Wilson

Gas Welds 6-Inch Pipe in 50 Seconds 45

Building a Job Welding Business 49
By W. Irving Brockson

Events and News of Interest 51

New Literature 53

New Products 54

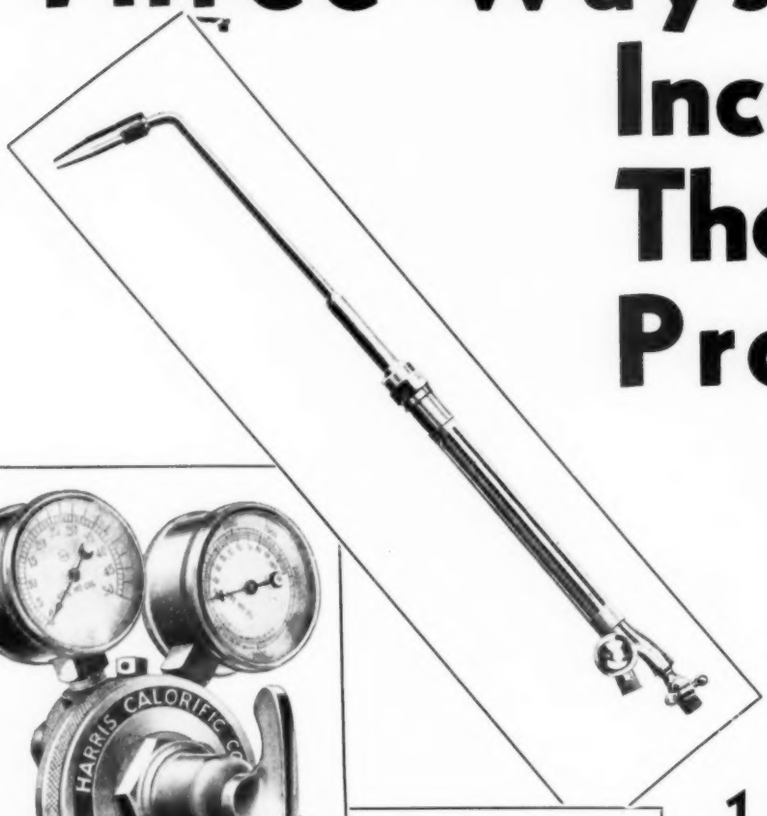
News of the Industry 56

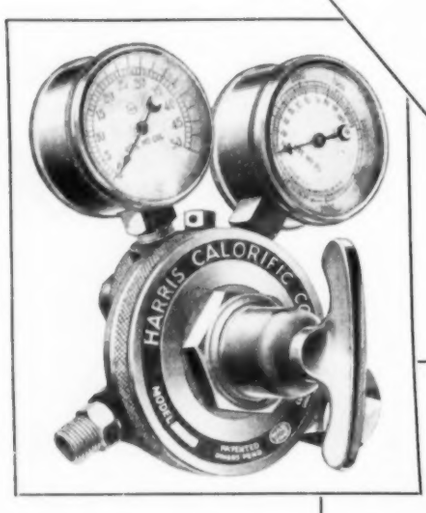
The Picture on the Cover*

This rather unusual test of welding wire is one of the many methods used by a manufacturer of welded pressure vessels, and described in the article, "Qualifying the Welding Wire" on page 27. Some of these tests have further possibilities for checking variations of operating technique, and determining how such variations affect both the weld metal and the parent metal.

**Photograph by courtesy of Henry Vogt Machine Co., Louisville, Ky.*

Three Ways To Increase Those 1932 Profits





1 The Harris Low Pressure Welding Torch which positively does not flash back. It makes good welding, and economical welding possible with low acetylene pressure. Operates with equal efficiency on high pressure cylinders, saving the gas that is often left in "empty" cylinders.

2 The HARRIS MULTI-STAGE Regulator eliminates practically all regulator upkeep expense and puts an end to all operating troubles formerly caused by inaccurate pressure control. All this is accomplished by the HARRIS method of reducing the gas pressure in two stages instead of a single stage.

3 The Harris "Red Head" Portable Acetylene Generator produces about 100 cu. ft. of acetylene per charge. Gas always available! It is easily the most convenient generator on the market to handle and operate—and saves about 70% of the cost of acetylene in tanks.

HARRIS CALORIFIC CO.
Cleveland, Ohio

EDITORIAL

Not So Hard on the Eyes

ALTHOUGH the welding industry has kept the public fairly well informed as to actual amount of eyesight hazard involved in welding, there still seems to be a persistent superstition in some quarters that this work is bad for the eyes, and some of them even consider that it is dangerous to a high degree. These opinions are contradicted by facts brought out by speakers at the recent Greater New York Safety Conference in a special session sponsored by the National Society for the Prevention of Blindness. Here it was estimated that out of the three million accidents occurring in the United States each year and causing a loss of one day's time or more, at least 10% are eye cases. It is further pointed out that the majority of eye accidents occur in the occupations in which hand tools and machinery are handled; that is, machinists and mechanics. It also appears that these eye accidents occur at times when men who should be wearing goggles are not wearing them. The obvious conclusion from this unbiased discussion is that the welder need have no fear about impairment of his eyesight so long as he observes the conventional and commonsense precaution of wearing the kind of eye protection which is designed for the work he is doing. This might be supplemented by the statement that any eye injuries due to welding were in most cases proved to be the welder's own fault.

Modernizing for Profit

HIGH executives in a number of important industries are giving thought at the present time to the development of a plan for a more complete modernizing of industry in general. This is a movement which might easily be misinterpreted to mean a general attempt to consign all equipment now in use to the scrap heap and start in all over again with all new equipment of the most up-to-date design. The project does not contemplate any such radical changes. The real purpose of it is to encourage executives in individual companies to modify existing operations so as to gain the utmost advantages from up-to-date procedures. In some cases there is great need for replacement of equipment which is really obsolete. In other cases equipment can be improved by more or less inexpensive alterations, and in still other cases a general reorganization of plant personnel, plant equipment and operating program is all that is necessary to increase efficiency. The purpose is to make present operations more profitable by taking advantage of such modernized procedures as will reduce production costs.

In the welding departments there is certainly much which can be accomplished. One good authority on the subject has recently stated that only 50% of the welding which is being done is quality welding, and that quality welding is the only kind of welding which yields a profit in the long run. To correct this condition there are two things to be considered. Probably the most important is that of the control which is exercised over welding operations. If this control is intelligently applied, the department operates with the greatest profit, but if the control is not adequate, there are many sources of profit leaks—no matter how much money is spent for the purpose of getting the best possible equipment and materials.

A second point to be considered is that each of the welding processes have been improved during the past two years to such an extent that performance data based upon the use of older procedures are considered obsolete by the plants using the improved methods of today. The changes and modifications which have been made in the fields of gas welding, arc welding and resistance welding have one fundamental principle in common which is a more efficient utilization of heat. No program of supervision is complete which does not provide for keeping up-to-date on these improvements which are being made both in processes and in procedures. It is going to be very profitable during years immediately ahead to see that the welding department is thoroughly modernized at least as to operating methods. The welding departments who fail to do this are quite apt to find themselves falling behind other departments who are keeping up with the general trend toward modernizing for better profits.

Values—Something to Boast About

ANOTHER outstanding example of the right way to sell the welded product is found in a recent magazine advertisement of the Aluminum Company of America. The subject of the advertisement was aluminum chairs. The advertisement, itself was printed partly with aluminum ink, making it an unusually expensive as well as attractive piece of copy. Illustrations in this copy were so well done that it was almost as good as an actual demonstration of the strength and serviceability of welded aluminum chairs. The point was strongly made that the welded article is not only as good as any other chair, but is actually stronger and better. Advertising along this line is beneficial to the welding industry as a whole. It lets the public know that the welding processes can be used to give the public better products, that is, better values. In the long run it will help to raise the standard of practice in the industry and to create a larger public demand for welded articles. Manufacturers who are doing good welding should not hesitate to let the world know about it—in fact, they should boast about it.

A Tip for the Job Welder

DATA obtained from a current survey of job welding shop activities indicates that probably less than 20 per cent of the job shops are getting any hard facing business. This is really surprising because there are scarcely any shops located where some potential hard facing business does not exist. The work is certainly a profit possibility because a few shops specialize in it and show good earnings. There are two things the job shop owner can do in the slack season to increase his hard facing business. First, he can make a study of the possible applications of the process; and, second, he can survey the plants and factories in his district to locate possible customers. If he does these two things he will find in most cases that there is enough work to be done to make it worth his while to learn how to do this work right and to spend some of his spare time selling the service.

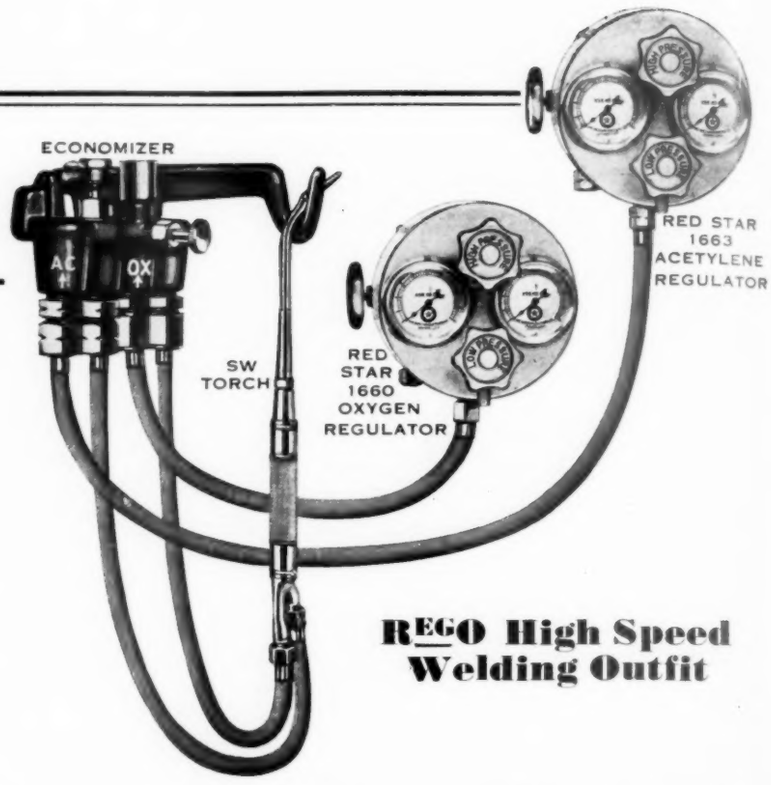
GAS

Welds Better—

Any Metal Anywhere Anytime

Oxy-acetylene welding has many advantages over other methods of manufacture and assembly on a production basis.

A gas weld can be made absolutely leakproof. It can be machined after welding. It is as flexible as the metals it joins. Gas welding is not limited to ferrous metals. Copper, brass, aluminum and many alloys are handled with equal facility.



REGO High Speed Welding Outfit

REGO Production Welding Methods

as applied to the welding of duplicate parts in large quantities place these operations on an entirely new efficiency basis. As a result, there is an appreciable improvement in the quality of the product, while at the same time the cost is reduced materially.

The Rego "High Speed" Welding Outfit is especially designed for mass production. It includes Red Star Duplex Regulators which maintain absolutely uniform delivery pressures and a neutral flame despite tank fluctuations. No time is lost through flame adjustments; no gas is wasted. Also included is the Rego Economizer, which shuts off the flame when the torch is hung on the hook and re-establishes the neutral flame by means of a pilot light when the torch is lifted from the hook.

Rego Welding Engineers are trained to solve unusual production problems. Write, giving full information, and our recommendations will be submitted without obligation.

The Bastian-Blessing Co.

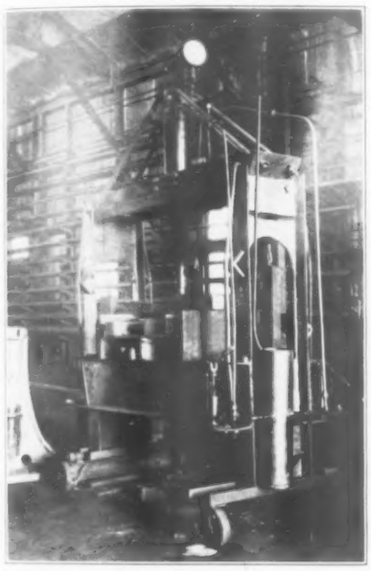
246 E. Ontario St. :: Chicago, Ill.

THE MONTHLY SYMPOSIUM

Production and Fabrication

Hydraulic Press

This press is five feet long by about six feet five inches high. It has a capacity of over 100 tons and is used for straightening large steel members used in the oil fields and shipyards near Long Beach, Cal. It will easily straighten up to 4x4-inch axles, large I-beams, rear housings for heavy gravel trucks, etc.



Hydraulic Press Welded of Scrap Material Has Large Capacity.

Construction of the press is entirely of scrap material found around the average blacksmith shop, which reduced the cost of the machine materially. Fifteen-inch I-beams form the upright supporting members at each end to which are welded 12-inch horizontal I-beams, which together form the main frame of the press. The upright I-beams are welded at the bottom to a 6-inch channel iron at the rear, and to a 6-inch I-beam at the front end, which form the two axles for the portable feature of the press. Odd scrap wheels about six inches in diameter are welded to the axles with the use of scrap pieces of bars and other material, which, together with a cleverly made fifth wheel of scrap boiler plate, and a short tongue welded in place, makes the piece of equipment easy to move about from place to place in the shop.

A piece of 6-inch Shelby tubing with ½-inch walls, properly machined, form the main plunger for the press which is operated by two pumps, one low pressure and another one for high pressure work. The low pressure pump has a 1½-inch plunger, while that of the high pressure pump has a ½-inch plunger. Oil of a special quality and consistency made for use in pumps of this kind is used in operating the press.

The main pressure piston has a clearance of 15 inches and is raised by an arrangement of two 50-pound iron weights suspended at each end of the press as seen in the photo. The truss rods over the top as shown are 1½ inches in diameter.

A welded container for the oil used in operating the pumps, made of an old piece of 8-inch pipe, is seen between the two pumps.

This interesting piece of welded equipment was designed and built by the D. & R. Welding & Blacksmith Shop in Long Beach, Cal., of which D. M. Powell is manager. The welding on the press, which was entirely by the electric arc process, was done by R. H. Anderson, also of Long Beach.

Grinding

By H. Loewenberg†

Modern manufacturing methods are including more and more the use of parts fabricated by welding, and many parts formerly made of cast iron now are made in the sheet metal shop. The welds on such work usually must be cleaned up to present a good appearance. For this purpose, flexible shaft equipment is used very extensively for finishing the welds to a smooth surface.

Figure 1 shows typical equipment used for this purpose. With this equipment, welded joints are dressed down with a grinding wheel very rapidly and easily to a smooth surface. Later, sanding drums and discs are used with the same equipment to smooth and finish the ground surface. The machine illustrated is best suited for light work. This machine can be furnished with a multiple speed arrangement or with a longer flexible shaft and a higher stand for floor work. Larger sizes of machines are available to suit the nature of the work.

Figure 2 shows some of the grinding done on sheet metal work and structural iron. At the left is a typical sheet metal cabinet to house the electrical controls of a well known automatic machine tool. This cabinet is built entirely by welding, after which the welds are dressed down, producing a very smooth and workmanlike job. To the right in this photograph is a typical structural iron bench unit which combines lightness with strength. Here again the welds are dressed down to smoothness by use of flexible shaft equipment.

A large fabricated sheet steel structure built entirely by welding is shown in Figure 3. Here again all joints are smoothed down by grinding. This is typical of many jobs now built and finished in this manner. Welded tanks

†*Keller Division, Pratt & Whitney Co.*

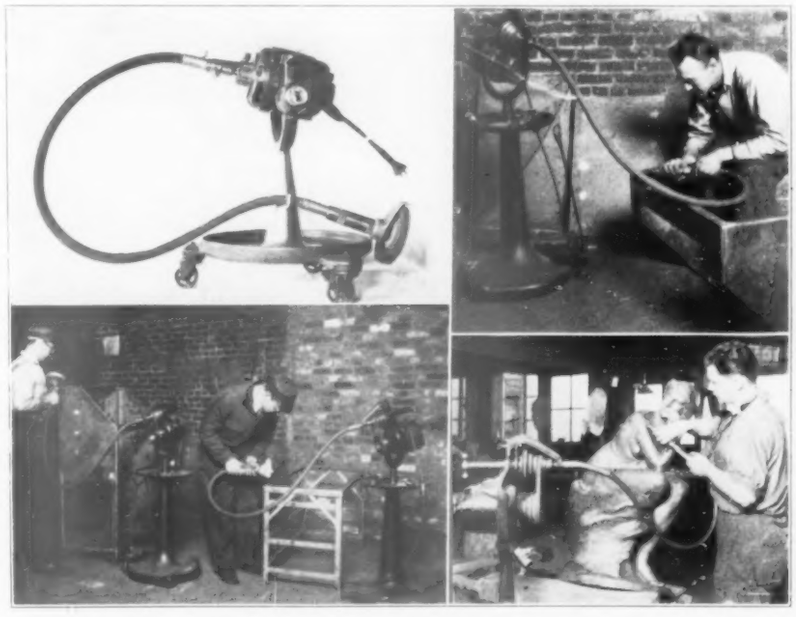


Figure 1. (Above, Left) Typical Flexible Shaft Equipment. Figure 2. (Below, Left) Grinding Equipment Handles Work of All Types. Figure 3. (Above, Right) Accessories Permit Smoothing Down Corner Welds. Figure 4. (Below, Right) Dressing Welds on a Bronze Statue.

are ground in the corners with small grinding wheels, and the great variety of wheel shapes available make possible almost any kind of finish in sheet metal work.

Ornamental iron work, wherever it is welded, is worked down with small wheels and with shaped stones. Welded bronze, particularly in architectural foundries, is cleaned by means of burrs and rotary files. Afterward, it is polished with sand drums.

The removal of welds on a bronze statue is illustrated in Figure 4. Flexible shaft equipment is used very widely in statuary work and is found in the studios of many famous sculptors. Grinding has a further wide use in finishing the moulds used for making brick and tile. Such moulds must have square, sharp corners, which used to be obtained by laborious hand tooling. Now these corners are produced easily and quickly.

Bearings

Bearings may be considered as a modification of bosses, but they are of very much more importance in the successful operation of a machine because the bearing is the point at which the load is taken. In general, it must be so designed so as to take this load and transmit it to the supporting members of the machine. We will assume in this discussion that the type and dimensions of a bearing have been determined and that it is purely a question of support and location.

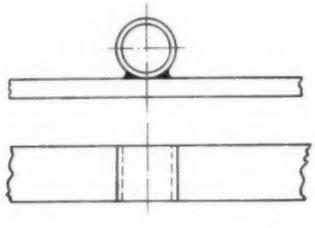


Figure 1.

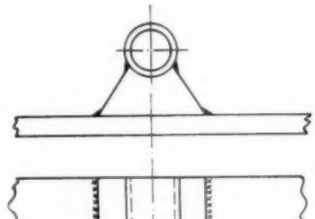


Figure 2.

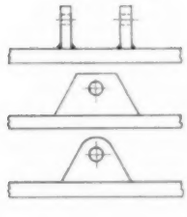


Figure 3.

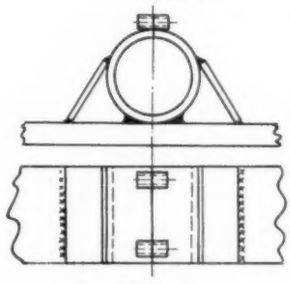


Figure 4.

The simplest bearing is, of course, pipe placed on a flat supporting member and welded thereto, such as is designated in Figure 1. Where the bearing must be raised due to the fact that increasing the height of the support would involve a large expenditure of material, then the bearing which may be made up of a pipe can be supported by a block such as is shown in Figure 2. This block may be shaped to give a good appearance or it may be merely a rectangular block. This, of course, involves more welding than Figure 1, but it does away with the need of raising the support as a whole.

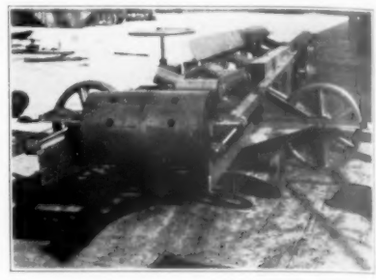
Another type of bearing consisting of two plates welded to the support is shown in Figure 3. This is used frequently in cases where levers are involved and is very simple and easily constructed. The bearing may be made of plates to the desired shape, depending upon the need for appearance, or may consist of rectangular blocks. The accuracy with which the center line of the bearing must be located will determine whether or not the parts may be drilled beforehand. This involves not only the bearing parts themselves but also the other parts of the machine.

A modification of the bearing shown in Figures 1 and 2 is that in Figure 4. This consists essentially of a split tube with bosses at the split for obtaining a slight variation in the diameter of the bearing and with plate stiffeners on the side. In the illustration shown the plates were bent and carried along the support members. This was made necessary by certain design requirements but it is also possible to use these plates without bending them and increasing the thickness of the supporting members to take care of the belts which fasten this removable bearing to the machine.—*From Application Sheet No. 26, Series 2, by Lincoln Electric Co.*

Garbage Conveyor

The main frame of this conveyor is of 4-inch angle iron, to which are welded cross members for supporting the rollers which carry the conveyor belt. Corner brace plates, after cutting and shaping to proper fit, are welded in place as seen in the picture.

This conveyor, which is a 50-foot span when fully assembled and installed, was built for the city of Phoenix, Ariz., by The Conveyor Company, of Huntington Park, Cal., of which J. Keith is welding foreman and shop superintendent. Mr. Keith states that in building this and various other similar equipment, their rule and policy is to use welding whenever possible and practical. This company designs and manufactures all kinds of conveyors, specially built industrial tanks, washing vats, etc., including large power driven brushing and polishing machines for lemons and other citrus fruit raised on a commercial basis.



"Welded Whenever Possible" Permits a Wide Range of Fabrication.

In all of the work of building these different types of equipment, welding plays a very important part, both in cutting and shaping specially made parts, and in obtaining ultimate maximum strength and rugged endurance for the machine or article being built.

Reinforcing Steel

Welding in the fabrication and securing of reinforcing steel for concrete viaduct and bridge work was recently put into practice by the city of Los Angeles, Cal., in the construction of a viaduct across the Union Pacific and Santa Fe railway tracks.

The manner of fabrication of the reinforcing steel in hinges, as they are termed, is shown clearly in Figure 1. Four of these hinges are anchored into the concrete at each abutment, which form what is termed the haunches. The arches of the viaduct are constructed in four sections termed rings, two of which are called railway rings and

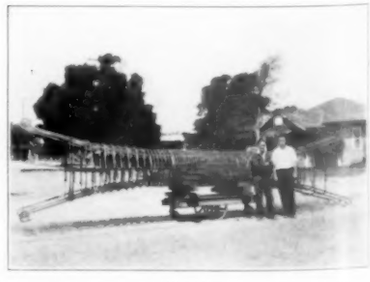


Figure 1.

two highway rings, and are so termed by reason of the viaduct serving both street railway and regular highway traffic. The hinge shown in Figure 1 is one of the railway spring hinges, which is larger than the highway hinges due to the greater load it carries. It is made up of 2¾-inch round stock variable pitch spirals 30 inches in diameter, interlocked and each secured with an 18-inch lace weld.

The highway haunches are similar to the railway haunches, except for diameter. The crown hinges, or those used at the crown or top of the arch, are three (instead of two) interlocked and welded spiral rings. These are for the railway hinges, while the highway crown hinges are the same as for the abutment haunches, except that they are smaller in diameter, and are also larger pitch.

A closeup view of some of the welds on this work is clearly shown in Figure 2. A total of 6,720 tack welds and 416 of the 18-inch lace welds were required in the fabrication of these spiral hinges. The use of welding in these members made possible a perfect piece of work which carried out the design accurately and also permitted handling on the job with no danger of damage to the members. Any other method would have been impractical, due to the great weight

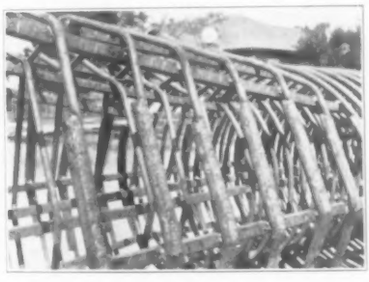


Figure 2.

and stresses. All of the welding of this reinforcing steel in this job was by the electric arc.

Figure 3 shows the haunch hinges extending out from their concrete anchorage in one of the abutments. In addition to these hinges, two rows of 1¼-inch square steel bars extend out above and below the hinges. These are termed intrados and extrodos, and compose the main reinforcing for the ring. These bars extend the full distance from haunch to haunch, and are welded together where they meet at the crown and to the dowel bars extending out from the abutments. Before welding was adopted, the requirement was that these bars must over-lap where they meet for nine feet, and were secured together by wiring. By the use of welding and the added strength thus attained, these laps at the crown and haunches were reduced to four feet with lap welds three feet and

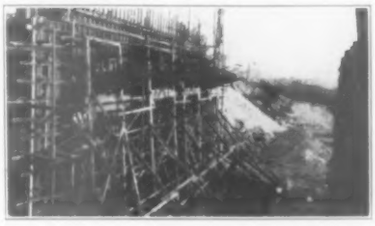


Figure 3.

six inches in length. The use of welding also made possible a smaller hinge section and a more effective supporting member.

These three-and-one-half-foot lap welds as required, were greatly in excess of the actual needs, as was pointed out by the engineers, but due to the difficult conditions under which much of the welding had to be done, such as narrow spaces under which to crawl necessitating cramped positions and poor vision for observing their work, overhead welding, etc., an allowance was made by increasing the length of the welds on these laps. Had it been possible to do this welding under shop conditions, 18-inch welds would have been sufficient to withstand any strain placed upon these members. About 1,300 feet of top welding and 1,100 feet of overhead work was required in these locations.

There were approximately 3,200 tons of this welded reinforcing steel used in this viaduct. Fabrication, welding, and placing of the reinforcing steel in the job was done by the Soule Steel Co., of Los Angeles. Plant fabrication and welding was done under the supervision of A. Aland, with G. Russell in charge of shop and field welding. Erection was under the direction of Chas. Blodgett, superintendent, and W. J. Cameron, resident engineer for the Soule Steel Co. Mr. L. Miedroth, engineer for the city of Los Angeles, was in charge of construction, and F. Brierly was assistant engineer in charge of steel work.

Special Steels

.65 Carbon

Question—Can you give me information as to the arc welding of .65 carbon steel? Is it necessary to preheat or anneal the work?

Answers—By P. P. Alexander, Thomson Research Laboratory, General Electric Co.: "I have found it necessary to preheat the work to about 300 to 400° C. before welding and annealing immediately afterward. I obtained best results by welding high carbon steel with atomic hydrogen process and using a welding rod containing 1.2 carbon. If the welding is done at medium speed, the resulting weld has carbon content of 0.6 to 0.65. Therefore, I think that the atomic hydrogen and welding rod of the above composition would give very good results on the above application. The welds produced by that process can be quenched and drawn in the standard way to obtain the desired characteristics.

"If the atomic hydrogen process is not available, I suggest the use of flux covered high carbon electrode or the use of a good bare high carbon wire. In the latter case the weld would have to be heat treated. The bare wire electrode, however, should not be more than 0.85 carbon. Of course, if it is not necessary to produce a weld of high strength and composition approaching that of the parent metal, other fluxed or bare wire electrodes could be used successfully although the produced welds are liable to crack during quenching and will be considerably weaker and more brittle than the parent metal."

By C. H. Jennings, Mechanics Div., Research Labs., Westinghouse Electric & Mfg. Co.: "Welding of 0.65 C. Steel will be difficult and the strength of the joint will not be equal to that of the original materal. The process of welding will 'burn out' some of the carbon from the base metal and will produce a hard, brittle zone adjacent to the weld. Heat treating the weld at a temperature high enough to produce grain refinement will eliminate this brittle zone. This heat treatment will not make the joint as strong as the original base metal, however, because of the lower carbon content at that point resulting from welding.

"In welding steels of this carbon content, residual stresses must be kept to a minimum in order to prevent cracking in the above mentioned brittle zone.

"I am not in a position to state what would happen if the welded joint was heat treated by quenching in oil. Also, as I have made no tests on welds made of steel of this carbon content, I can make no statement as to their exact physical properties.

"The following suggestions will be helpful in connection with welding 0.65 C. steels.

"1. If possible, have the ends of the pieces to be welded free so that they may move, thereby eliminating residual stresses as much as possible.

"2. Use a high grade fluxed welding electrode.

"3. Puddle the molten metal with the electrode. The carbon lost by the

base metal forms a gas which must pass through the molten pool of deposited metal. If the deposited metal is not kept in the molten state long enough for this gas to escape, the weld will be porous.

"4. Peening is often helpful in reducing residual stresses.

"5. Heat treat the finished weld at a temperature high enough to produce grain refinement."

From the Journal of the American Welding Society, February, 1932.

Nitralloy

Nitralloy steel is a chrome molybdenum alloy containing approximately one percent aluminum. It is a strong, tough, wear-resisting steel which takes a hard surface with the hardness gradually decreasing toward the center. The gradual decrease in the hardness gives the steel a high impact resistance. It is said to be very valuable for valves in internal combustion engines, pistons, piston pins, steam turbine valves and buckets. Engineers of the Federal Machine & Welder Co. were asked about the possibility of welding this steel by the resistance process because the material has become so important for the construction of machine parts, tools, etc. Investigation disclosed that previous attempts at welding had been unsatisfactory because of the tendency of the aluminum to oxidize and leave oxide inclusions in the weld. The nitriding operation failed where these oxide inclusions occurred and left soft spots.

Samples of the material were obtained and some additional experiments conducted by the Federal organization. The technique was finally developed which made it possible to produce welds having satisfactory hardening properties. One report received states, "The case hardness is excellent and apparently uniform and without soft spots the whole length of the sample. The appearance of these samples both before and after nitriding is very good and we had considerable difficulty in finding the location of the weld to obtain the sample for examination."

M. L. Eckman, of the Federal Machine & Welder Co., states that 1-inch pieces are successfully flash welded on a standard hand operated butt welding machine. This steel does not flash or upset like ordinary machine steel but more like a very good grade of high speed steel. In other words, there is little absorption of heat into the body itself. Therefore, the flashing must be rather long and the upset instantaneous and powerful. It is considered that the formation of aluminum oxides is prevented by the arc flame surrounding the junction of the metals and keeping the air away. Steel one inch in diameter can be welded at the rate of 150 per hour, and steel two inches in diameter at the rate of 80 to 100 pieces per hour. The weld will show an enlarged grain structure which is a typical result of any localized application of heat to a normalized steel structure and occurs in all types of steel regardless of the manner of heating. It is also considered that this grain structure can be reduced to very nearly normal by suitable heat treatment immediately after welding.

Nitralloy is being used extensively in the industrial sections of the east and middle-west for the manufacture of dies, cutting tools and machine parts.

Stainless

Although the welding of stainless steel is no longer difficult, an unusual application sometimes arises which offers more of a problem than the mere welding process. Such a problem presented itself recently and its solution offers a possible aid to many others using this comparatively new alloy.

In making an Allegheny Metal food container, a manufacturer wanted to solder the seam an the inside of the tank, also to weld along the outer flange for greater strength. Solder would cover the seam smoothly and prevent food particles from lodging which might decay and contaminate subsequent batches. He found, however, that after the welding operation had been performed, a hard oxide deposit in the seam prevented the solder from adhering. If the process were reversed, the high temperature required for welding (3200° F.) would melt the solder (melting point, 450°).

Engineers of Joseph T. Ryerson & Son, Inc., Chicago, suggested a plan that was successfully demonstrated before the Waukegan, Ill., Welding Society recently. To avoid the objectionable deposit of oxide, the tank was soldered and partly filled with water before welding. The water served to check the intense welding heat that followed, and prevented the solder from melting. Ryerson Allegheny Metal Welding Rod

Water in the Shell During Welding Prevents Melting the Solder.

and a Type "S" Wilson Welder were used in conducting this test. An Allegheny solder and special flux carried by Ryerson Company was supplied for the soldering application.

Weld Design

Structural Assemblies

Assembled members are generally designed lighter for welding than for riveting. A welded roof truss has few if any gusset plates, and its tension members require no allowance for rivet holes; welding saves 20 to 30 percent in weight of roof trusses. In very heavy trusses, such as are used to carry floors of buildings and sometimes multi-story columns in addition, welding does not eliminate gussets but greatly reduces their size and weight, because far more stress can be transferred per square inch of gusset surface by welds than by rivets; Figure 1 is a photo of a gusseted joint in a heavy welded truss. Welded plate girders are made of plate material without angles; the effective depth is therefore a larger proportion of total depth than in a riveted girder; furthermore, no allowance need be made for rivet holes in tension flange; stiffeners are plates instead of angles and are, therefore, about half the weight of those for riveting, and no fillers are needed between stiffeners and web. Not only are welded plate girders lighter than riveted ones, but they are stronger for a given section modulus because their compression flanges are additionally braced by being welded to the stiffeners. Figure 2 shows a pair of heavy plate girders; the additional flange plates have been made thicker than prevailing practice in riveted construction, because no holes need be punched or drilled

Figure 1. Gusset Joint in a Heavy Welded Truss.

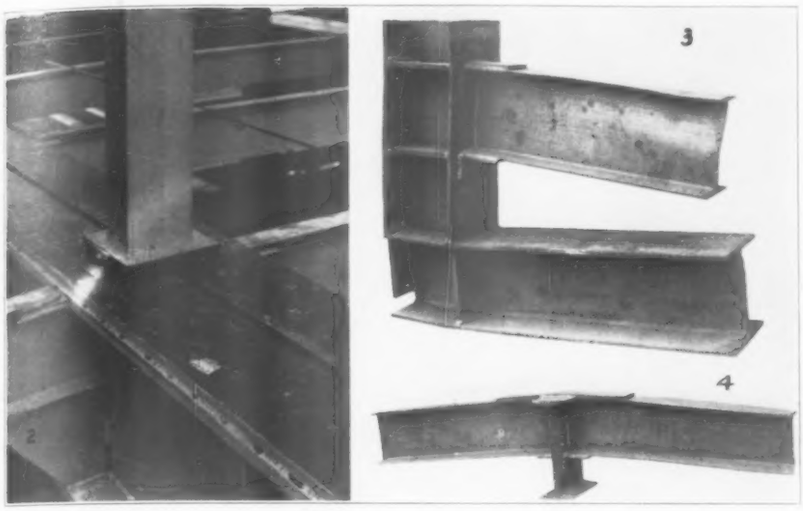


Figure 2. Plate Girders with Additional Flange Plates Welded On. Figure 3. Test of Beam-to-Column Connection. Figure 4. Test of Continuous Beam-to-Girder Connection.

through them, and because multiplicity of plates would seriously waste welding. For wind bracing, welded beam-to-column connections are especially advantageous and provide 100 percent bending strength and the limit of possible stiffness whenever required, as illustrated by the test specimen of Figure 3. Continuous beams are practicable with welding and are sometimes advantageous; Figure 4 shows a test specimen which illustrates one economical form of continuous beam-to-girder connection. All beams and girders in the framework shown in Figure 5 are continuous.

Figure 5. All Beams and Girders Are Continuous.

[Extract from a paper, "Application of the Code for Fusion Welding and Gas Cutting," read by Gilbert D. Fish, Consulting Structural Engineer for the Westinghouse Electric & Mfg. Co., before the American Welding Society, New York Section, Nov. 18, 1930.]

Redesign

Sometimes after a product has been designed to be welded, a still further improvement in the production economy and in the product itself can be brought out by redesigning. An interesting case is described in the February issue of *Oxy-Acetylene Tips*. The production in question was a pressure feed tank for paint spraying and industrial air brush equipment.

This was a pressed steel tank having a removable lid or cover which is lifted off when refilling or changing the color of the paint. Since the cover must fit well enough to resist 100 lbs. per square inch air pressure and still be easily removable, the method of locking it to the tank is very important. A locking device was designed which proved practical, and then it became necessary to attach a circular chrome-molybdenum steel flange to the lid in which the locking device could fit.

The cost of attaching this flange by riveting was very high, so riveting was abandoned, and oxy-acetylene welding substituted. Later, a serviceman noticed the job and suggested that a still further improvement could be made by redesigning the flange so as to permit welding on the inside instead of on the outside, and recommended the use of bronze welding in place of using a steel filler rod. The result of following this suggestion was that the welding time was reduced from 25 minutes to eight minutes, with a corresponding economy in the materials used. It further developed that locating the joint on the inside eliminated the necessity of smoothing up the weld prior to painting the tank.

New Applications

Valves

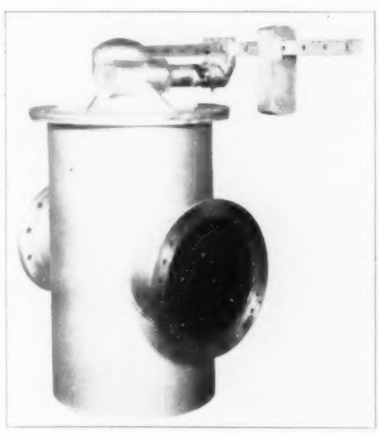
Another unusual piece of equipment for the oil industry has been developed and perfected in the American Tank & Equipment Corp. plant at Oklahoma City, the manufacturing subsidiary of Black, Sivalls & Bryson, Inc., of Bartlesville, Okla. This is a 14-inch gas valve of the balanced type for use on the gas discharge line of oil and gas separators.

The 14-inch gas valve has been installed on the Marshall Oil Company's Buxton No. 1 Well where it was put in service December 14, 1931. The valve performed very efficiently and has resulted in four other valves of the same size and type being manufactured by B. S. & B."

This unit handles the entire gas discharge from one of the big American Oil & Gas Separators, used in the Oklahoma City field, and takes the place of two cast iron semi-balanced gas valves and one 8-inch cast iron gate valve. The separators used in the Oklahoma City field are of the Improved American type, in either the 7-foot diameter by 24-foot 2-inch high separator or the size 7-foot by 27-foot American separator. The 14-inch valve, as fabricated by "B. S. & B." is the largest partially balanced gas regulator valve of its type ever built for use in the oil industry. It is fabricated entirely out of steel plate, welded and machined by Black, Sivalls & Bryson at their Oklahoma City plant.

The decision to fabricate so large a valve out of welded steel plates instead of the usual cast iron or cast steel type, was based entirely upon price. To have a pattern to cast the body parts for this valve would have cost a considerable sum of money. Unless hundreds of these valves could have been cast from the same pattern the cost of a cast steel or cast iron valve would have been prohibitive. On the contrary, a single valve fabricated out of steel plates can be made at a very reasonable cost.

Black, Sivalls & Bryson, Inc., are in position to make other similar devices of this nature through the welding up of steel plates in the place of making heavy castings. A material saving could often be made where a relatively small number of these products are required.

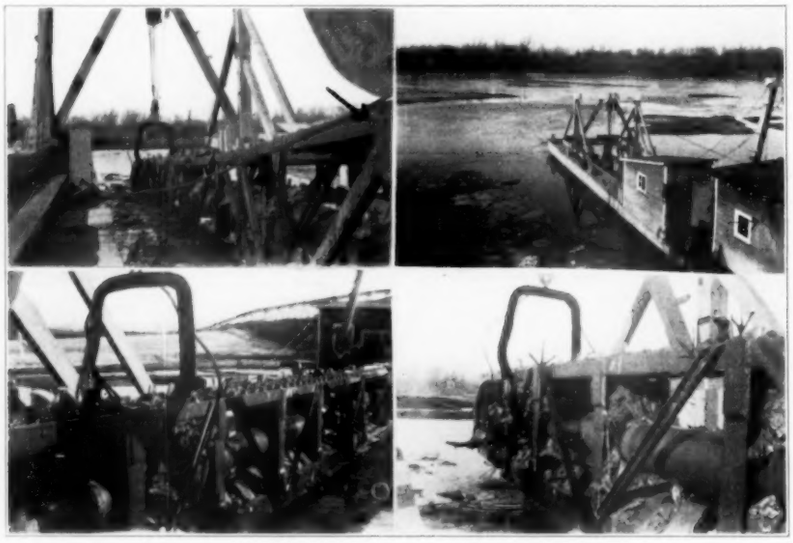


Welded Construction Was the Only Economical Way.

Digger Boom

A rather novel application of welding to heavy duty equipment is a digger boom which was fabricated by the Topeka Arc Welding Co., Topeka, Kan. This boom was made to operate on a sand boat belonging to the Victory Sand Company, who operate the largest sand plant in that vicinity. It has been in operation about eighteen months, and so far there has not been a single failure in any of the welds. A short time ago the owners shut down the plant and raised the digger out of the river to allow taking the photographs which accompany this article.

Mr. Meinholdt, proprietor of the Topeka Arc Welding Co., states that they were asked to make a bid on this boom along with several other construction companies, and his company was the only one to turn in a bid for an all-welded structure. Both bolted and riveted structures were given consideration, and bids were turned in on that basis. The bid for the arc welded job is said to have been slightly higher but there was a considerable saving in transportation, because the entire unit could be welded on the job and this saving was enough to more than offset the difference in the bids.



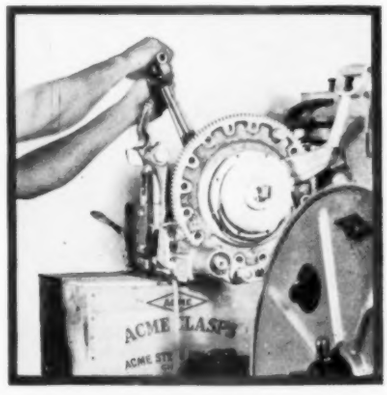
The Only Bid for Welding Got This Job. It Pays to Offer Welding Service.

The boom was constructed by welding one-inch plates 4 inches wide to the top angle iron, which is 4x4x⅜ inch and to the I-beam centers. In the photographs it is impossible to see this I-beam on account of the rocks piled up between the joints. This boom was lengthened about 25 or 30 feet and is slightly tapered towards the ends. There is a 10-inch pipe running through the center forming the suction line. An endless chain runs inside the angle iron on the sides. The diagonal cross braces shown in the picture are 4-inch channels.

Tying Bundles

There are probably few people who would think of using a spot welder for tying bundles and packages, but the fact is that this is an application of spot welding which has proven to be very successful in practice. The equipment for doing this work is manufactured by the Acme Steel Co., 2840 Archer Ave., Chicago, Ill., and the name Acme Weldfast has been given to the device. This is a strapping machine which binds up boxes, packages, bundles or bales with a steel band, which is furnished in large coils and mounted on a reel which is part of the equipment.

The reinforcement value of the band when used on boxes is dependent upon the degree of tension given to the band before sealing, the temper and strength of the steel and the efficiency of the sealed joint. The Weldfast machine makes a joint which tests fully 95 percent of the strength of the band itself and is justly considered to be superior to any other method of joining steel bands for this purpose. The band used has a galvanized finish which makes a good weld and protects the steel from rusting. The whole machine is portable and has a range of 25 feet from the electric outlet. It can be used either with or without a conveyor system. Standard equipment operates on a 60-cycle, 110 and 220-volt A.C. For other shop currents, specially wound transformers can be supplied. The manufacturers state that one k.w. hour supplies enough current for 1,000 welded joints.



First the Band Is Tightened and Cut Off, Then a Pull on Lever Joins the Ends Permanently.

This packaging machine can be operated by one man, and no great skill is necessary. The band is drawn from the coil and looped around the package preparatory to being gripped by the jaws of the stretching mechanism. A single forward pull of one lever revolves a large gear which tightens the band around the box or the package. The cutting lever is moved down with the other hand and shears the band from the coil at the exact point where the welded joint will be made. The operator then pulls the welding lever forward, making the electric contact for the weld and completing the band. 2,000

Complete Acme Weldfast Unit.

bands per day can be applied by one man on single strap shipments, averaging three to four straps per minute, including the time needed to handle the shipments on and off the machine. Where more than one band is put on each unit or where the conveyor systems carrying the material, even a greater number of bands can be applied in a day.

This ingenious machine is adaptable to practically any size package and is being used for a variety of products, ranging from small packages of railroad tie plugs to large cases of rubber goods and bales of wood pulp weighing over 300 pounds. The spot weld produces a tight, one-piece steel band which makes it impossible to open the package without leaving positive evidence of tampering.

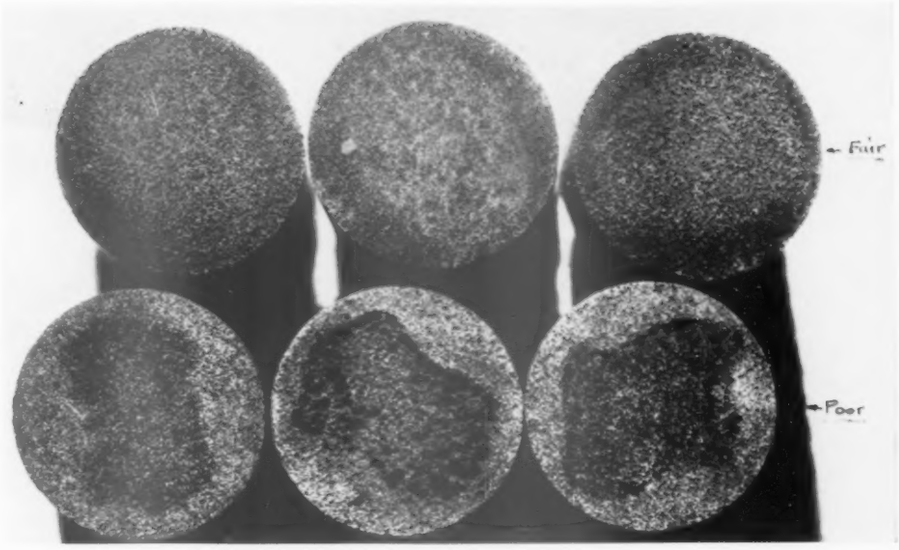


Figure 1. A Simple Method of Checking Segregations and Non-Uniform Structures in Welding Wire. Those Shown in the Top Row Will Pass Standard Requirements While the Defects Shown in the Bottom Row Show Segregations Due to a Non-Uniform Structure.

Qualifying the Welding Wire*

By G. W. Plinke†

With the increased attention being given to the quality of welds, no feature of procedure can be neglected. The author discusses the qualities of welding wire and points out methods of determining the results that may be expected. The exacting investigations of the quality of the deposited metal are typical of the tendency to rate welding wire largely on the basis of performance in the higher grade welding which is involved in pressure vessel construction.

NEW applications have imposed more rigid requirements upon welding and welding technique. The adoption of fusion welding by the American Society of Mechanical Engineers for pressure vessels has made it mandatory for manufacturers to develop their welding to a high degree of perfection. The object of this discussion is to point out essential requirements fundamental to the attainment of higher grade welding and the importance of using good welding rods.

In the primary development of a high-grade welding procedure, both for electric arc and oxy-acetylene welding, most of the large concerns commercially interested in welding began their research on the assumption that the weld metal should possess characteristics of tensile strength, ductility, structure, resistance to shock and specific gravity at least equal to those of the parent plate. Weld metal suitable for high-grade work must be metallurgically sound.

Both the oxy-acetylene and electric arc methods of welding play important parts in the welding industry of today and each process has special merit in certain fields of application. For this reason, and also because rods and manner of deposition are quite different, the processes will be discussed separately. With the electric arc welding process, the commonest method of welding has been with bare rods or electrodes. Even without covering, the deposited weld metal is remarkably improved when good, clean welding rods are used.

To secure the desired type of weld metal, it is very essential to make a careful study and analysis of the available welding rods. Other factors being the same, a weld can be little better than the quality of the welding rods. These rods should be purchased from a manufacturer or supply company of unquestionable reputation, but even then, unless it is known beyond any doubt whatsoever that rods are manufactured to strict specification based on exact chemical and physical tests, every shipment should be carefully checked and rod which does not come up to the standard set should be rejected. Examination should not stop with mere chemical analysis as is often the case. A very inferior quality of welding rod may check up satisfactorily for the chemical analysis. Sample rods should be taken from different bundles in each shipment, and sections cut from each rod. These sections should then be ground on a medium fine emery wheel on each end until the saw marks are removed. By carefully etching these end surfaces, the chemical heterogeneity of the material

*From a paper read at the Seventh Annual Welding Conference, Purdue University, Lafayette, Ind., December, 1931.

†Research Engineer, Henry Vogt Machine Co., Louisville, Ky.

becomes apparent. Fig. 1 shows a marked variation in chemical heterogeneity of two welding rods, both of which have the same chemical analysis. The structure of the rods shown in the top row (Fig. 1) is good and will pass standard requirements. The structure of the rods shown in the bottom row is poor. They contain segregations due to a non-uniform structure which is so clearly manifested in porosity and pipes that high-grade modern welding

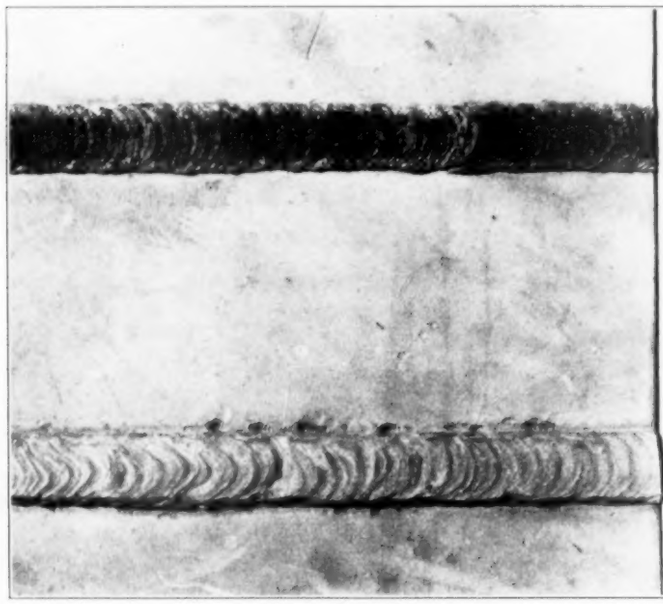


Figure 2. The Bare Rod Weld (Above) Has Been Eaten Away After Being Submerged in Acid Solution While There Is Little Change in the Coated Rod Weld (Below).

Figure 3. Welds Similar to Those in Figure 2 Were Given a Bend Test with the Result that the Coated Rod Weld Shows Superior Characteristics of Ductility. The Bare Rod Weld Shows the Fracture.

could not be accomplished with this low quality rod.

The physical properties of this type of metal deposited from mild steel rods are as follows:

Tensile strength—45,000 to 50,000 lb. per sq. in.
Elongation in 2 in.—8 to 15 per cent.
Reduction of area—20 to 25 per cent.
Charpy impact values—8 to 12 foot-pounds.

A microscopic study of this type weld shows very often that the weld metal contains a number of defects such as porosity, cracks, segregations, nitrides, oxides and incomplete fusion. Weld metal with such defects will not stand up under a severe pressure test and is usually found to be very brittle. Microscopic investigation in conjunction with other tests reveals that it is the presence of the nitrides in the weld which causes most of this brittleness. These nitrides are a result of contamination with the gases of the atmosphere during the deposition of the molten metal.

In order to prevent this atmospheric contamination, some type of coated rod should be used. With the coated welding rod, as well as with the bare rod, the same care should be exercised to prevent rods coming into use that have not been physically and chemically tested.

Care should be used to select a rod which has the proper diameter for the nature of work being done. This factor should be carefully studied by the welding supervisor so that the sizes will be adapted to the conditions of the job and the technique employed. The current and amperage of the welding machine also must be varied according to the nature of the work and the diameter of the welding rod. Light sheet metal and plate require only a small amount of amperage. This amperage should be increased proportionately to the diameter of welding rod and thickness of plate.

Experience and practice will teach a welder to recognize the type of weld deposited during the welding operation. Through the use of covered rods and following the proper technique, the physical quality of deposited metal will be materially improved. The physical properties of this type of metal deposited from mild steel rods are as follows:

Tensile strength—65,000 to 72,000 lb. per sq. in.
Elongation in 2 in.—25 to 30 per cent.
Reduction in area—50 to 68 per cent.
Charpy impact values—20 to 40 foot-pounds.
Specific gravity—7.84 to 7.854.

By using the covered welding rod many additional significant qualities in the weld metal are obtained. Fig. 2 shows two parallel weld beads laid down on a ½ in. plate. Bare rods were used on one bead and covered rods were used on the other. The specimen was then submerged for 75 hours in a 1-1 solution of hydrochloric acid at a temperature of approximately 80 degrees F. (room temperature). The bare-rod weld shows a honeycombed structure which has been eaten out by the action of the acid, while the covered-rod weld is relatively unaffected. Consequently it is obvious that the corrosion resistance of the covered rod weld is far superior to that of the bare-rod weld. Fig. 3 shows two welded beads laid down in a similar manner, one being a bare-rod weld and the other a covered-rod weld as before. The plate was then bent through an angle of approximately 130 degrees. The bare-rod weld cracked and failed and in so doing the crack extended into the parent plate. The covered-rod weld showed no sign of fracture. Here as in the corrosion test the superiority of the protected-rod weld is just as obvious.

In determining the ductility of the weld metal in a welded joint, the bend test is of considerable importance. The bend test specimen is marked with center punch marks in the weld metal on the outside fibres. The dis-

tance between center marks is taken and the specimen is then bent until flat upon itself or until fracture occurs. After bending, the distance between center marks is again taken and the per cent elongation on the outside fibres calculated. Fig. 4 shows views of a bend specimen 2½ in. thick by 4 in. wide which had an elongation on the outside fibres of 64 per cent. The purpose of this illustration is not to specifically present or advertise a 64 per cent elongation on a bend specimen, as results such as this have often been obtained, but to present a clearer picture of the manner in which the material is stressed in the bend test.

It is of vital importance that thorough fusion be obtained in a weld to insure a high joint efficiency and prevent any possible failure in the weld. The most accurate method of determining whether good fusion has been obtained in a weld is by miscroscopic study. However, a good physical test is shown in Fig. 5. A 1 in. square section was cut longitudinally from a welded plate, including one-half weld material and one-half parent material. The 1 in. square section was forged to a ¾ in. round section at a temperature never exceeding 1,300 degrees F. After forging, the specimen was machined and the shavings were allowed to remain on the specimen as they curled up in machining. There was no breaking off of shavings at the junction of the weld and parent metal, proving that there was perfect fusion between the weld and the plate. This test may also be used to indicate that the metal was not embrittled through the forging operation as would result should the weld metal contain a large amount of sulphur.

There are a large number of people who have conceded that welding is now entirely scientific and that welds can be and are being made on a commercial scale equal to and stronger than the parent plate, yet they will argue without any apparent reason that the plate material has been harmed and the structure damaged to such an extent as to extend 4 or 5 inches away from the weld, and therefore contend without good reason that the weak point of a joint is just away from the weld. This is not the case, however, since it is clearly evident from the photo micrographs in Fig. 6 and Fig 7 that the plate material is not harmed in the vicinity of the weld. Several micro-sections were cut from a welded plate as follows: 5 in., 3½ in., 2⅜ in., $1\frac{3}{16}$ in., ⅝ in., ⅜in., $\frac{3}{16}$ in. and ⅛ in. away from the fusion zone of the weld and also micro-sections were cut from the fusion zone and in the weld metal. These sections were all examined microscopically at 100 magnification, the structure and characteristics of which are shown in Figs. 6 and 7. The structure of the plate shown microscopically is characteristic of ordinary good quality plate material from five inches away from the fusion zone up to ⅜ in. away from the fusion zone. Closer than this as shown by microscopic examination, there is revealed a gradual grain refinement in the structure of the plate. The grain refinement is increased in approaching the fusion zone and is at a maximum in the weld itself. In the fusion zone the structure of the plate is refined by the heat from the weld to such an extent that the structure of the plate and the structure of the weld gradually merge or blend into each other without any sharp line of demarcation. Immediately in the weld the refinement is the best, showing a structure that is absolutely free from all harmful defects. Results of innumerable tests of this nature have been practically the same in all cases, proving that the weld properties are consistent and that the structure in the plate is unaffected other than for a gradual grain refinement as the fusion zone is approached. This tends to improve the structure of the plate material in the proximity of the fusion zone, where the need for good structure and strength is desirable to insure against any possible failure in the weld or in proximity to the weld. The finer structure is due solely to the gradual uniform temperature gradiant where partial and total recrystalization has taken place. This recrystalization, gradually blending from the weld into the parent material, indicates thorough fusion and strength.

As an additional help in the determining of the quality of a weld the X-Ray has played an important part. A weld can be X-Rayed and a radiograph of the weld obtained. By careful study of the radiograph the porosity, lack of fusion and any inclusions are readily detected for further examination. The specimen can be sectioned through the flaws which can then be analyzed microscopically and efforts directed toward overcoming them. We can often help a welder overcome his faults by showing him a radiograph of his weld so he can see just where trouble has occurred and how it appears. Explanation can be made to him as to the probable causes and he can then be shown how to correct them. By actually seeing a "picture" of his work the lesson is more forcibly brought to his attention. The psychological effect upon the welder is of considerable consequence.

The X-Ray affords an excellent means for the non-destructive testing of pressure vessels and enables a manufacturer to produce a welded vessel with a complete set of radiographs of the welded joints which can be shown to the purchaser to eliminate any doubt as to the character of the welds.

Figure 4. Side and End Views of a Bend Test Specimen, 2½ Inches by 4 Inches, Which Shows an Elongation of 64%.

Ferrous and Non-Ferrous Alloys

Alloy steels have gained recognition very rapidly in the past few years and manufacturers are constantly finding many new applications for them. The welding of these steels is therefore an important problem. In practically every case the welding of an alloy steel requires a rod of

the same alloy. The chrome nickel steels are being used to a very great extent. The 18-8 steel (18% chrome—8% nickel) is a stainless Austenitic alloy steel and is being used extensively for lining tanks where corrosion resistance is an important factor. It is also used extensively for valves and fittings in the oil industry. In the welding of the chrome nickel steels, the welding technique for electric arc welding is somewhat different than that employed with the low carbon steels. It is necessary to change the current characteristics in order to obtain satisfactory welds. In most cases covered rods are used and the same general precautions must be observed in welding these alloy steels as in the welding of low carbon steels. The welding is done somewhat faster, care being exercised to avoid puddling or working the deposited weld metal.

Oxy-acetylene welding is also used in the welding of chrome nickel steels with good results. A special flux is available which will prevent contamination of the puddle from the atmosphere and will dissolve with ease the refractory chromium oxide formed during welding. Such a flux should always be used for oxy-acetylene welding alloy steels containing a considerable percentage of chromium. Welding should be carried through to completion as rapidly as possible and overheating of the base metal should be avoided.

The atomic-hydrogen process has been found useful in preventing harmful atmospheric contamination in welding materials with a special affinity for oxygen such as aluminum. Excellent results are secured in welding aluminum and nitralloy with this process, although the electric arc method has given fair results with aluminum when a special flux covered welding rod is used. However, the oxy-acetylene and oxy-hydrogen methods are most generally used, with aluminum rods of various compositions and a proper flux. The oxy-hydrogen method is rarely used for the thicker aluminum plates and shapes.

Figure 5. A Physical Test for Good Fusion. A Forged Section of Weld and Parent Metal Shows No Break in the Shaving When Machined.

Oxy-Acetylene Welding

To obtain high grade oxy-acetylene welds the same fundamental principles apply as in electric welding. One of the most essential requisites is the use of good, clean welding rods. It is a significant fact that the oxy-acetylene industry has always advocated high quality welding rod and has imposed strict chemical, physical and weldability requirements for rod upon the steel mills; consequently, they deserve a great deal of credit for the present trend toward quality welding rods. Manufacturers have learned to demand a better grade of material and this in turn has been reflected back to the steel mills. It was then necessary for the mills to keep the chemical analyses within closer limits and to secure the desired physical properties in their respective melts. This has all worked for the betterment of the industry in general.

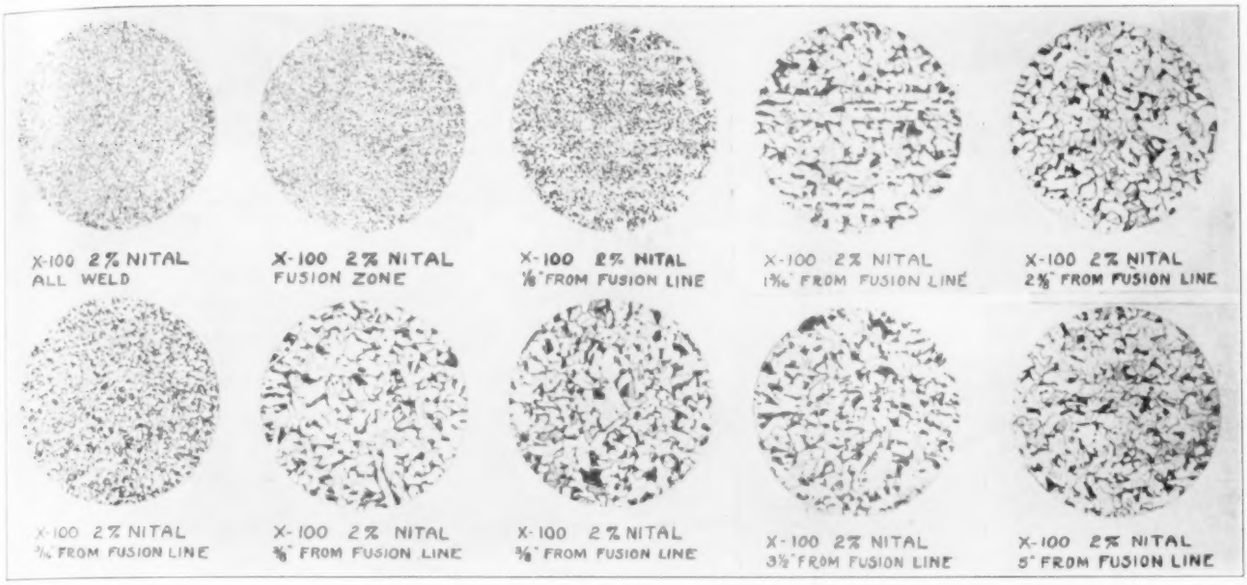
As much skill is necessary in welding by the oxy-acetylene process as with other welding methods. A welder must learn the proper manipulation of the torch and know just when to use a neutral, an oxidizing or a reducing flame. To obtain perfect fusion, it is essential that the plate surfaces or scarfs be in a molten state just preceding the welding puddle as the rod material is welded in the puddle at the same time. Care must be taken to prevent excessive oxidation of the base metal or filler material, caused by holding the flame in one location too long, or by using the wrong type of flame. The art of depositing the molten rod material is only learned by careful observation and constant practice.

The oxy-acetylene industry was the first to recognize the value of preventing atmospheric contamination in welding. Although the flame protects the puddle from contamination to a considerable extent, special self-fluxing rods are used where high quality welding is demanded, and the type of flame and technique employed is carefully controlled to give the greatest possible protection to the puddle. With the use of satisfactory, low-carbon welding rods, oxy-acetylene welds have been made in ordinary plate with tensile strength ranging from 45,000 lbs. per sq. in. to 55,000 lbs. per sq. in. Where special self-fluxing rods have been employed for welding high strength boiler plate, tensile strengths have been secured in the weld metal ranging from 55,000 lbs. per sq. in. to 65,000 lbs. per sq. in. With special rods and a reducing type flame, welds have been made in high-carbon plate with strengths up to 100,000 lbs. per sq. in. in the weld metal. The ductility of properly made oxy-acetylene welds is generally excellent.

The size of the welding rods is also an important factor in oxy-acetylene welding. Further, it is essential to have a full knowledge and understanding of the size and type of tip for the torch as this has much to do with obtaining a high grade weld. For various sizes of rod the tips must vary accordingly to accommodate the rod and the thickness of the base metal.

The fact that oxy-acetylene welding is applicable to practically every metal and alloy in common use makes it almost indispensable to manufacturers of specially designed metal products. There are many alloy steels that can be more successfully welded by oxy-acetylene than by the electric method. The field of application for the different type welding processes is varied and judgment must be used by the welder or his supervisor in selecting the method for various kinds of work.

Oxy-acetylene welding is very essential in the foundry. For welding or building up metal on cast iron, the oxy-acetylene method is far superior to the electric method. Special high grade cast iron welding rod should be used in welding cast iron. One of the principal requisites



Figures 6 and 7. Microscopic Examination of a Specimen Extending from the Weld Zone to Five Inches Away Shows No Sharp Line of Demarcation. There is a Gradual Grain Refinement in the Plate Which Reaches a Maximum in the Weld Itself.

necessary for good results in proper heat treating prior to and during welding, always bearing in mind the size of the section and uniformity of the temperature gradient. Work should be well heated before starting any welding. This temperature should be maintained during the welding operation and on completion the work should be slowly cooled either in a furnace or through the use of some improvised means, such as covering with ashes or some material which will prevent the rapid dissipation of heat resulting in chilling.

"The Ideal Application"— A Goal to Strive for

By Paul B. Covey*

What do we mean by "the ideal application"? Well, one dictionary tells us that an "ideal" is "an imaginary state of perfection." Therefore, an ideal application must refer to a state of affairs where electric welding is used in such a manner that in every detail we find nothing but perfection.

But, you say, if an ideal refers to a state of perfection why waste our time in idle dreaming? We all know that we can never hope to reach anything like perfection.

"Idle dreaming" is wasteful—but dreaming of an "ideal" is far different. There is no fun in striving with all our might for something easily within our reach—real pleasure comes only as we exert ourselves to attain those things which require real effort on our part. It is in this conscious striving on our part to advance further and further toward our ideals that we receive the greatest real enjoyment.

So, in our thoughts of welding, let's visualize for ourselves a state of perfection—a series of conditions in which we find electric welding perfectly applied; in all of its various phases, to the fabrication and erection of structural steel.

First, there is the problem of design. To be welded economically a structure must be properly designed for welding. A structure designed for bolting or riveting will prove expensive if welded.

Next, there are the innumerable details of construction —connections, ties, struts, braces and so forth. These, too, must be properly prepared especially for welding.

Then, there is the fabrication itself—with all its separate problems such as equipment, supplies, templets, jigs, clamps, technique and so forth.

Next comes the matter of supervision, including such allied duties as securing qualified welders, training those not up to "standard," controlling the welding operation itself, inspection and approval.

Also, there are such matters to be considered as painting, shipping, erection and many other vitally important problems.

As we think over the various phases of this welding program, we can surely agree that we are far, very far, from the "ideal" in most every case. There are so many ways in which our present procedure is far from perfect.

So, as intimated above, let's think about these problems one by one and imagine what would be an ideal condition for each case in the hope that through our imaginings there might be brought out some points which would be of help to the welding industry in its endeavor to reach the highest in point of service and economy.

Next month we shall take our first step into the land of make-believe and think together of the question of designing steel structures especially for welding and see what our imaginations will suggest in the way of "ideals" in this connection.

*Consulting Welding Engineer, Manchester, N. H.

Big Contracts Can Be Made Bigger

By Elmer H. Smith†

A Minneapolis contractor is able to double or triple the size of a welding contract by searching out every possible welding application when he is estimating the pipe welding on a new building. On a single item illustrated he made a profit and saved the builder $300.00.

THERE have been many welded heating systems constructed in the last few years in Minneapolis and St. Paul in office buildings, school buildings, institutions and other similar structures. One of the most recent of these is the Ramsey Junior High School of Minneapolis, which has just been completed. This new building faces Nicollet Avenue near the corner of Forty-ninth Street and obtains its heat from the present boiler plant located to the rear of the present Washburn High School, approximately 1000 feet distant from the new building.

A tunnel leads from the Washburn High School to the Ramsey Junior High School, and affords communication between the two buildings, aside from the passage of the steam pipe lines. Between these buildings, on the surface, is to be located the athletic field for the two schools.

In the boiler room of the Washburn school, the arrangment of boilers and steam headers was such that the additional heating requirements of the new Ramsey Junior High School necessitated extension of the old straight line header from the old boiler to form a ring or loop. The space in the old boiler room was limited and two short radius 180 degree turns were required in this header. The diameter of the old header was sixteen inches and it was necessary to carefully fit the new loop bends to the existing piping in the boiler room, the bends being made to an extremely short radius.

An attempt was made to secure these bends in Minneapolis, but they were not available and finally bids were obtained for them from pipe shops in Chicago at $750.00 each. Slow delivery and the freight on the bends from Chicago to Minneapolis did not make this proposition an attractive one and the welding contractor who had had many years of experience in this class of work availed himself of the advantages of the welding process and fabricated his own bends.

It was necessary to complete this portion of the job promptly and there was no sixteen inch pipe available at the time in the Twin Cities. Furthermore, the method used was found to be less expensive than the purchase of sixteen inch pipe if it had been available.

The welding contractor prepared careful templets of the bends and fabricated these bends in his own shop by rolling three-eighths inch plate into a long tube, welding the longitudinal seam, and with the cutting torch cutting segments from the pipe. The rolled section was then bent in until these openings closed and each joint was welded with the torch. This work was well done and the only equipment required, aside from the welding outfit, was a preheating torch and a roller.

Figure 1 illustrates a portion of this header after it had been covered. In the center of the straight portion of this loop, an interesting form of dished head drip pot is shown. A piece of pipe, smaller in diameter, was welded to the bottom of the header pipe, after a dished head and an even smaller diameter drain had been welded in place. This construction is clearly illustrated in the figure and makes a drip pot which will not accumulate sediment.

It is interesting to note that this welding contractor makes a practice of welding all piping with the torch. At the same time, he includes with the welding contract many accessories, such as pipe supports, hangers, brackets, etc., and considerable structural work, which is usually done with the arc.

An example of expert fabricating on the job is shown in Figure 2. This branch from the header is ten inch pipe and two double bends have been made to permit this pipe to leave the top of the header above the valve in the old boiler room and to drip down into the tunnel to the new school building. All of the bends are double forty-five degree joints which do not restrict the flow of steam through the pipes appreciably. The steam is pushed through these offtake pipes, shown in Figure 2, and through one thousand feet of tunnel to the new building with a loss in pressure of less than three-quarters of a pound. With fittings, the construction would have been very difficult and costly.

To get out of the boiler room and into the tunnel required five bends, one of which is illustrated in Figure 3. The change in direction of each of these bends was ninety degrees and the diameters of the pipe illustrated were ten-inch, six-inch, three-inch and two-inch. All bends were fabricated by the welding contractor by notching the pipe, or cutting segments from it on the inside of the bend, heating the pipe with the preheating torch, pulling the openings together and welding the joints. These bends were made of pipe of the diameters given. One of the channel supports furnished by the welding contractor is illustrated in this photograph. These were cut to length with the cutting torch.

At certain points, and especially in the long straight section through the tunnel, it was necessary to provide for expansion. As there was not room in the tunnel for a U-bend, and it was not desired to offset the tunnel, as is done sometimes to take care of such construction, piston type expansion joints, shown in Figure 4, were provided for this purpose. The tunnel is 900 feet long and there are three such expansion joints in this distance. The supports for these joints were furnished by the welding contractor and are largely arc welded. Fabrica-

†*President, Smith Welding Equipment Corp., Minneapolis, Minn.*

tion was facilitated with the cutting torch and certain parts were bolted together where removal might be necessary to repack the expansion joint.

The tunnel between the two buildings is shown in Figure 5. It is of concrete construction and is a splendid job. The length is 900 feet and two ten-inch and one six-inch steam mains, all butt welded, pass through this tunnel supported by cross-beams and rollers. These rollers provide free movement of the pipe and the three piston type expansion joints, previously mentioned, compensate for expansion. The two small return lines on the side wall of the tunnel, as well as the hangers, are all welded construction.

The entire heating system from the sixteen-inch diameter ring header in the boiler room to the one and one-half, and in some cases, one-inch pipe, are all welded. Six welders worked for approximately five months and made thousands of welded joints. The test pressure was 125 pounds of cold water and when the system was completed and this test made, only one leak was found.

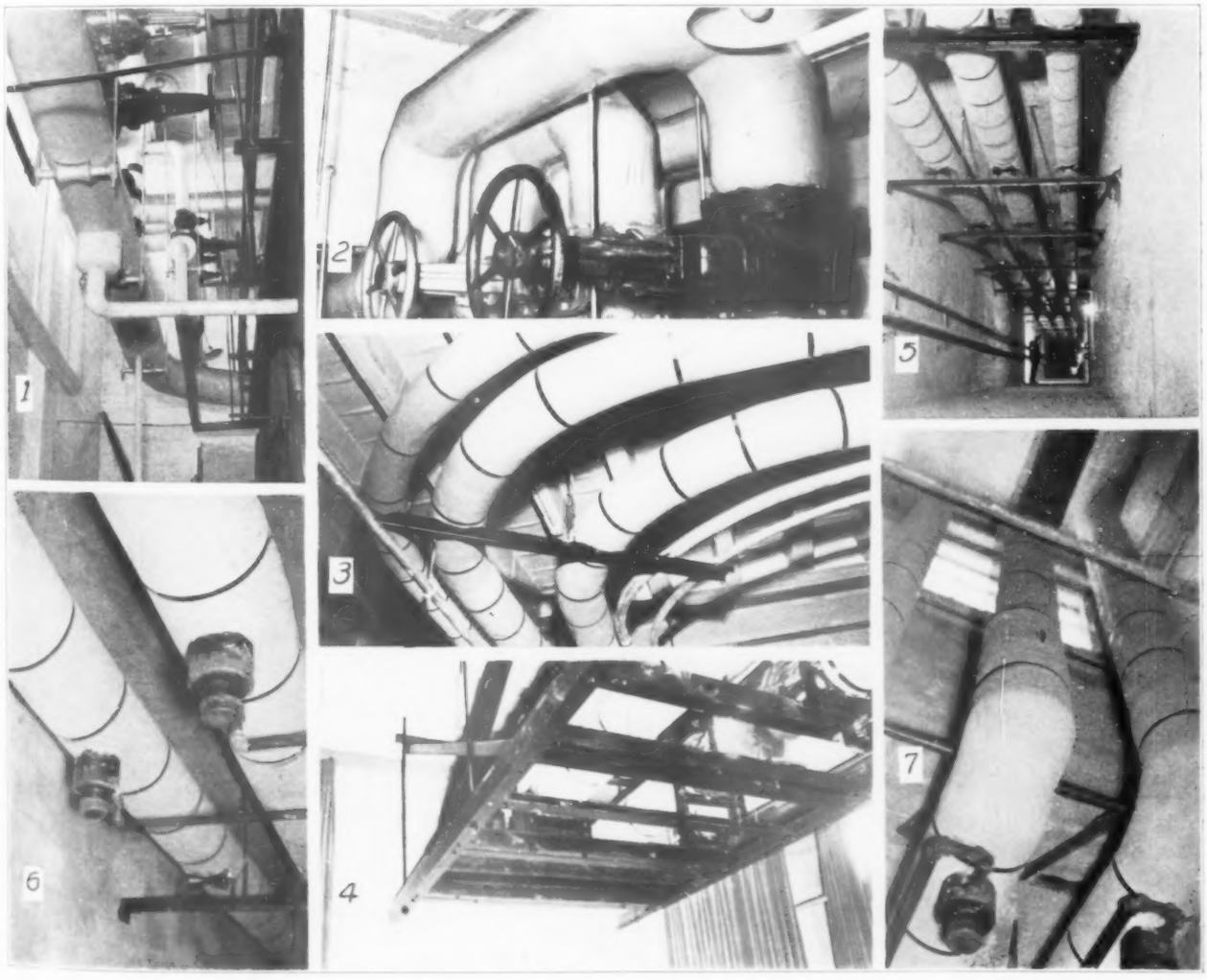
It was, of course, quickly repaired with the torch and the test was declared satisfactory.

Two drip pots in the steam line in the tunnel are shown in Figure 6. These are simple in construction, inexpensive to make and enable the removal of condensate and sediment without difficulty. In the side of the larger part of each trap a small pipe is welded leading to the return, and the cap may be removed to clean out the drip when required.

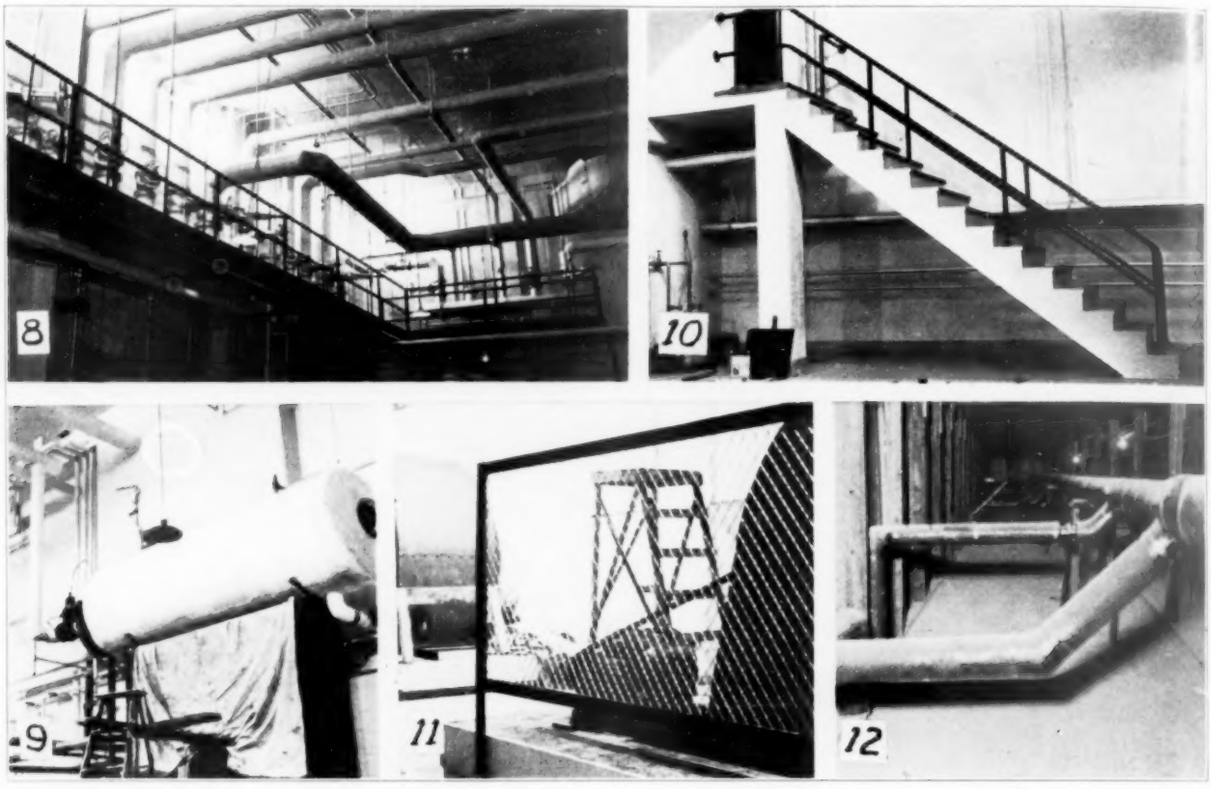
At the end of the tunnel in the new building the steam mains rise in a vertical shaft to the attic. These risers are shown in Figure 7. Drip pots are located at the lower part of the main before the bend carries them upward. Condensate drains from these drip pots are clearly shown in this figure. The bends in the mains are made of double forty-five degree joints, all fabricated by the welding contractor in his own shop.

Figure 8 is a view of the pump and distributing rooms in the new building. Part of the steam is delivered to a header and distributed into blast heaters. Condensation is accumulated here and pumped back into the boiler. All headers were fabricated in the welding contractor's shop. The railings, gratings and ladders are all of welded construction and were furnished by the welding contractor.

The hot water tank stand shown in Figure 9 is of welded construction supplied by the welding contractor. Figure 10 shows a beautiful job of stairway railing in the pump room, fabricated with the welding torch. Railing of this kind, welded throughout, is a better job from every standpoint. It has a better appearance, is cleaner and much stronger than the fitted job. The contractor



Here Are Several Examples of the Work Which Was Done by a Minneapolis Contractor by Scouting Out Every Possible Application for His Services.



Figures 9, 10 and 11 Are Further Examples of Extra Welding that the Wide Awake Contractor Can Find Around a New Building Project.

on this job was welding-minded. He missed nothing that could be economically welded, either with the torch or the arc.

Figure 11 illustrates another job which the welding contractor did not miss. All of the guards in the fan room are made of pipe with welded joints. The screening is welded to the channel iron frame.

In Figure 12 one branch of the attic main is shown. The leads taken off of this branch for the radiators below are clearly indicated and the supports under the main pipes are shown. The welding contractor made the supports of angle iron frames and thereby saved the contractor $300.00. The specifications called for concrete supports, but the angle iron supports were substituted with this saving and also a saving in weight.

The Ramsey Junior High School is one of three large jobs contracted for by the Industrial Welding & Manufacturing Corporation of Minneapolis who are the welding contractors referred to in this paper. Three or four years ago the president and general manager of this company came to the conclusion that a welding shop could do a great deal more welding on a job of this kind than just the pipe itself. He proceeded to familiarize himself with the construction and details of hundreds of other parts and structures which might be welded, and trained himself to bid upon this work effectively. In welding contracting it is just as important that the contractors know the costs of such work, as to know how to do it.

The result of these efforts and this training is that this welding shop can obtain contracts ranging from ten to twenty thousand dollars for a complete job instead of welding the pipe alone, which might not be more than two or three thousand dollars. This shop is and has been busy, employing from fifteen to twenty men all of whom are skilled welders of considerable experience. Every new man employed in this shop must pass a very rigid test, generally similar to that demanded by the new boiler code.

It is obvious that combined with a pipe welding job hundreds of brackets, supports, railings, stacks, coal bins, structural steel work, water tanks and other similar construction can be welded, at the same time, with a tremendous saving and greatly to the advantage of the welding contractor. In one of these buildings recently this same contractor included in his contract for welding pipe, the job of cutting down and removing an old steel stack which had served its purpose. Other welding shops can profit by the experience of this shop in Minneapolis.

Metal Congress in Buffalo This Year

Buffalo was selected for the fourteenth annual National Metal Congress and Exposition at a meeting of the Board of Directors of the American Society for Steel Treating in Cleveland, February 5th. The week of October 3, 1932 was chosen as the date.

The Exposition and afternoon technical sessions of the Congress will be held at 174th Regimental Armory, a huge building which offers 105,000 square feet of exhibit space, free from pillars and with every exposition facility. Ample and attractive meeting rooms for all Societies in the Congress are available within the Armory building.

This will be the first year that the National Metal Congress and Exposition has been held in Buffalo, W. H. Eisenman, Secretary of the American Society for Steel Treating and Director of the National Metal Exposition, announced.

The author is well known in America and in Europe as an authority on electric resistance welding and is associated with one of the largest automobile concerns in the world which adequately qualifies him to discuss the factors of design in

Resistance Welding Transformers*

By P. W. Fassler

THE characteristics of a transformer for welding service are influenced by many factors not encountered in other lines of transformer application. The transformer, being an integral part of the welder, is influenced in shape and size by the mechanical assembly of the welder. While the designer must adhere to all the electrical laws involved in any transformer design, he must also be sure that his finished product will fit as a unit of the machine.

There are three general types of transformers used in welders, namely: the Shell Type (Figure 1); the Core Type (Figure 2); and the Fassler Type (Figures 3 and 10), which belongs to the core type, but is distinguished from the conventional core type transformer by the secondary winding.

The major factors involved in the design of a transformer are, the nature of the welding duty; the mechanical features of the machine; the load cycle; the voltage used on the power lines in the plant where the welder will be in operation; the cycles of that voltage; the range of secondary or welding voltages, to give the proper flexibility, and the K. V. A. that will be required.

The welding duty influences many features of a transformer. In considering a conventional spot welder, either type of transformer will give good service. The writer feels that the use of the Fassler Type leads to a more compact style of spot welder (Figure 4) inasmuch as the secondary casting is used for mechanical purposes as well as electrical. Either type gives good results in butt welding and in flash welding. In relief welders of capacities greater than two hundred K. V. A., we would prefer the shell type transformer for mechanical reasons and construction costs. In welding presses of large capacities it is necessary to develop pressures of several tons on the electrodes. A superstructure built of copper or brass would be too costly. Electrically, we would prefer the Fassler type because of its superior magnetic coupling and ability to deliver a more uniform heat throughout the welding cycle.

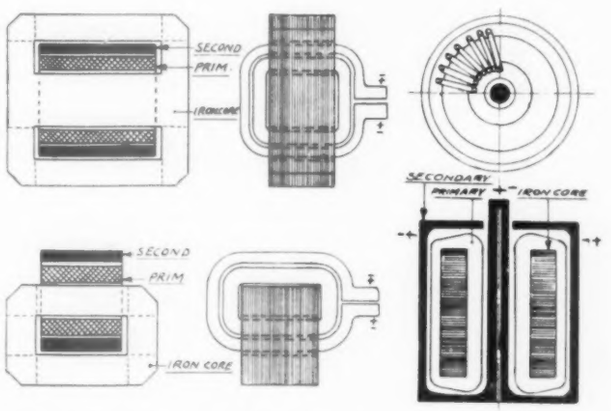
The secondary voltage of the transformer depends entirely on the welding duty. A spot welder for general use must have secondary voltages ranging from two to eight volts; flash welders must have voltages from four to ten volts; butt welders from three to ten volts. A seam welder needs from eight to ten different voltages to cope with all welding conditions. The portable welding tool, a special application of the spot welder, requires voltages from four to ten volts to compensate for the drop in the cables feeding from the transformer to the tool.

*Copyright 1932, by P. W. Fassler.

The K. V. A. capacity of the transformer depends to a large degree on the welding duty. A spot welder intended to weld thin sheet metal would have a low K. V. A. rating as well as a low secondary voltage, but a spot welder for welding $\frac{1}{8}$ in. metal to $\frac{3}{16}$ in. metal would require a fifty to sixty K. V. A. rating with a welding voltage of six to eight volts on present-day load cycles.

Transformer Design

There are three major parts to a welding transformer, namely, the iron core, the primary coil, and the secondary coil. The iron core is built up with segments of transformer sheet metal with a permeability of 10,000 lines per square centimeter and ranging in thickness from 22 gauge to 27 gauge. Figure 1 illustrates the core assembly in the shell type transformer; Figure 2 shows the core of a conventional core type transformer, and Figure 3 shows the core of a Fassler type transformer as used in spot welders. Several methods are used to clamp the sheet metal in as



Three General Types of Welder Transformers: Figure 1 (Above, Left) Shell Type; Figure 2 (Below, Left) Core Type; Figure 3 (Right) Fassler Type.

a unit. Clamps made from castings give good results, and clamps made from structural steel welded together are equally good.

The primary coil can be wound with round wire in sizes of transformers up to ninety K. V. A. at 440 volts, and with flat copper ribbon in larger sizes. Both the core and the shell type construction lend themselves to the pan-

cake coil construction, which is more or less necessary to use in transformers of large capacity (Figure 5).

With few exceptions, the secondary consists of one turn of heavy cross-section. This can either be built up with .007 in. copper sheets, or can be a casting. In the Fassler type transformer the secondary is always a copper casting or a high copper content brass casting. A recently designed transformer of 42 K. V. A. capacity for portable welding tools has a two-turn copper secondary casting.

Cooling the transformers on welders working on a heavy duty cycle is of great importance. While fan cooling has advantages, the writer prefers water cooling the secondary, which in turn cools the primary. Oil cooling has been under consideration and has possibilities.

In deciding on any particular type of transformer it is very important to consider the effect the magnetic coupling will have on the performance of the welder. Transformers for seam welders can have a relatively loose magnetic coupling, particularly so if a synchronous interrupter is to be used with the welder. A transformer for portable welding tool application should have as good a magnetic coupling as possible. A two-turn secondary is an improvement over the one-turn secondary in the shell and core type transformers and can be used on this duty. Transformers for relief welding should have a close magnetic coupling. Spot welding and flash welding give the designer greater leeway as far as the magnetic coupling is concerned. In Butt welding, where the weld is up-set at the finish, a close coupling is desirable.

A general outline of the many factors that influence the design of a welding transformer has been given in the preceding paragraphs. A specific problem in transformer design will show how these data are applied.

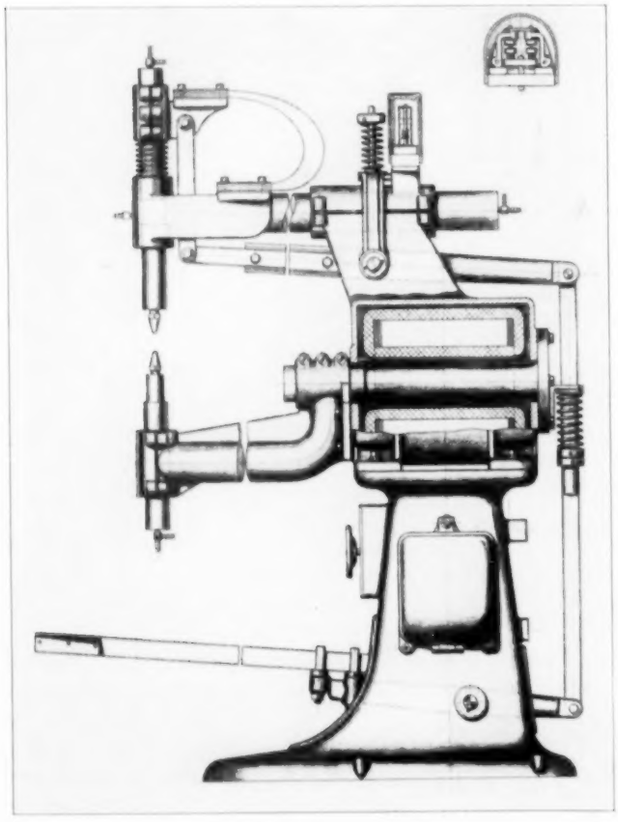


Figure 4. Fassler Type Transformer. Note Compact Construction of Spot Welder.

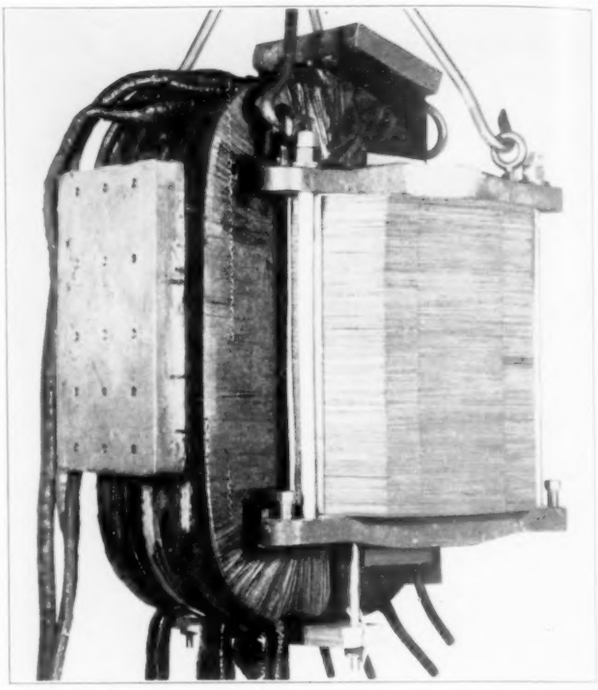


Figure 5. Large Capacity Transformer Using Pancake Coil Construction.

The designer of a transformer for a welding machine must always be conscious of the important functions a transformer has in relation to the welding duty the completed welding machine will be expected to perform.

If an analogy be permitted between the human being and a welder, then the transformer can be likened to the soul and the mechanical assembly to the brain.

For those not familiar with electrical phenomena we must explain that a transformer is a means of changing an alternating voltage from a higher to a lower voltage, or vice versa.

To make the fundamental principles clearer to the uninitiated, let us picture an interesting experiment:

First, let us take a coil of wire and impress an alternating current voltage on it. We will find that a magnetic field has been established in and around this coil of variable intensity due to the A. C. characteristics of the supply (Figure 6). Let us bring a second coil within the influence of the field of the first coil (Figure 7). If we now connect a voltmeter across the open ends of this second coil, we shall find an electro-motive force set up in this coil. We shall further find that the electro-motive force established bears a definite relation to the relative number of turns in the two coils. If we now interpose a magnetic conductor, such as soft iron, in the cores of both coils in such a way as to facilitate the travel of the magnetic flux from one coil to the other we shall find that all of these results have been intensified many times (Figure 8).

Spot Welder Transformer Design of 10 K. V. A. Capacity

The first consideration in the design of any transformer is the core dimensions because the core influences the physical dimensions of the primary coil and the secondary coil. In order to determine the size of the core we use the following formula:

$$Q=\frac{E\times 10^8}{4.44\times B\times S}$$

Q=Square Centimeter Area of the Iron Core.
E=Selected Secondary Voltage.
B=Permeability of the Transformer Sheet Metal (varying from 9,000 to 15,000).
S=Frequency.

$$Q=\frac{3\times 10^8}{4.44\times 10{,}000\times 60}$$

Q=112.3 Square Centimeters or 17.2 Square Inches.

Primary Coil. The number of turns in a Primary Coil is determined by the following formula:

$$Z_1=\frac{Z_2\times E_1}{E_2}$$

E_1=Primary Voltage.
E_2=Secondary Voltage.
Z_1=Number of turns in Primary Coil.
Z_2=Number of turns in Secondary Coil.

We will assume a primary voltage of 440 volts and a secondary voltage of 3 volts.

$$\text{Therefore } Z_1=\frac{1\times 440}{3}$$

Z_1=147 turns.

The cross-sectional area of the wire used in the primary coil is determined by the following formula:

$$I=\frac{P}{E}$$

I=Amperes.
P=Volt amperes.
E=Voltage impressed on coil.

$$I=\frac{10{,}000}{440}$$

I=22.7 amperes.

Assuming a current density of 2 amperes per square millimeter, the cross-sectional area of the wire would be:

$$\frac{22.7}{2}=11.35 \text{ square millimeters.}$$

Referring to our electrical handbook, which has a table showing current capacities of different wire sizes, we find that we will need No. 9 B & S gauge wire.

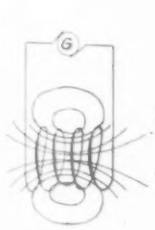


Figure 6.

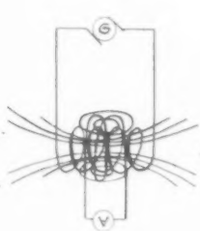


Figure 7.

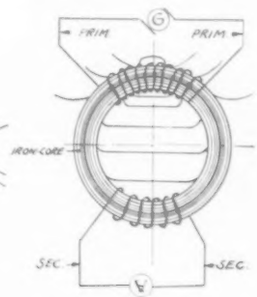


Figure 8.

To make our welding machine more flexible we will give our transformer a range of five different secondary voltages. The 3-volt step will be the highest with a differential of .25 volts between steps, making the lowest step 2 volts. The wire sizes for these lower steps are determined in the same manner as the top step.

Secondary Coil. The cross-sectional area of the secondary casting is determined by the same formula:

$$I=\frac{10{,}000}{3}$$

I=3,333.33 amperes.

The cross-sectional area of the secondary casting would be:

$$\frac{3{,}333.33}{2}=1{,}666.66 \text{ square millimeters.}$$

1,666.66 sq. Mm.=16.66 Sq. Cm.×2.58 Sq. In.

For practical purposes we will use 3 sq. in. as the cross-sectional area of our secondary casting.

Welder Transformer Design for Special Applications

Our problem is to design a transformer for a butt welder which is to be used for welding both flanges to an automobile rear axle housing in one operation.

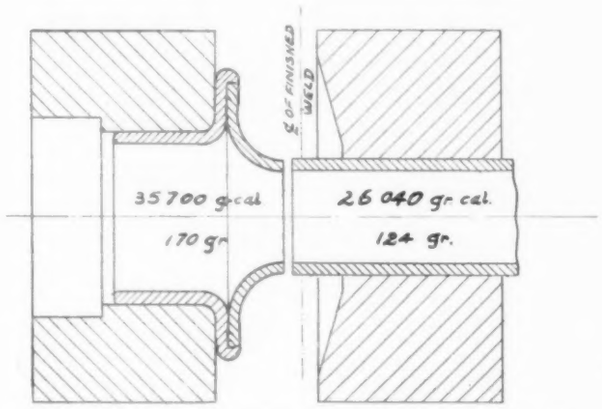


Figure 9. Diagram Showing Transformer Design Problem in Butt Welding.

We must first determine the amount of heat units in calories needed to bring the metal to the welding temperature. We find that the amount of metal included between the electrodes of one-half of the machine (Figure 9) is 170 grams in the hub and 124 grams in the rear axle housing, making a total of 294 grams. Therefore the total mass of the metal to be heated on both sides of the machine is 588 grams. We find from our handbook that it will take 230 gram calories to heat 1 gram of steel

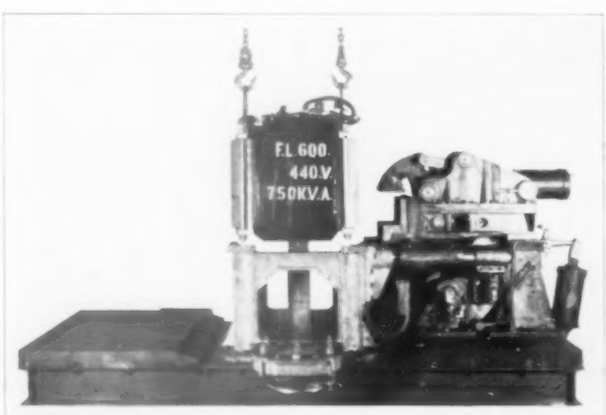


Figure 10. Fassler Type Transformer in Partially Assembled Welder.

from 1 degree Centigrade to 1,400 degrees Centigrade, which is the theoretical temperature we need for welding. For our purpose we will use a lower average of 210 gram calories per gram. (See September, 1931, issue for article on "Joules Law and the Welder.")

Therefore 588 grams × 210 gram calories = 123,480 gram calories.

Using Joule's Law of the relation of heat to work, and knowing the time required to make the weld, we can arrive at the necessary kilowatt capacity of the transformer.

Q (Quantity of heat in gram calories)=.238 I E T.

$Q = .238\ I^2\ R\ T.$

I=Amperes.

T=Time in seconds.

E=Volts.

R=Resistance in ohms.

$$IE\ (\text{watts}) = \frac{Q}{.238\ T}$$

$$IE = \frac{123{,}480}{.476} = 259{,}411 \text{ watts}$$

or

259.41 Kilowatts

To allow a safety factor and to take care of power factor conditions, we would design our transformer for 375 K. V. A.

There is much difference of opinion as to how welding transformers should be rated. Some authorities advocate the K. W. rating, while others advocate the K. V. A. rating. Considering the transformer as a unit and not as a part of the welder it is possible to determine its power factor, but as soon as we connect contact springs and electrodes and introduce welding stock, we introduce a variable condition of induction which no longer makes it possible to maintain uniform conditions of power factor. The writer therefore feels that the K. V. A. rating is a better rating than the K. W. rating.

Fatigue Strength and Strain Relief*

(Concluded)

By Charles H. Jennings†

RESIDUAL STRESSES—As mentioned in the introduction, the use of heavy sections and complicated structures in present day welding practice has increased the need for data on residual stresses and their elimination. At the present time, there are three recognized methods for reducing or eliminating residual welding strains or stresses.

1. Proper design of the welded joints and structure[6].
2. Proper welding procedure and welding technique[7].
3. Annealing of the welded structure[8].

The question of proper weld design has been extensively discussed and a knowledge of the general principles is fairly well known. As a result, only the second and third methods of strain relief will be discussed.

A. Strain Relief by Welding Procedure[7].

In order to study the effect of welding procedure on the reduction of residual stresses, the writer conducted a series of tests on six different welding procedures. These welding procedures are shown in Figures 12 to 14 inclusive. Complete information concerning them is given in the figures.

The test specimens used in the investigation contained a 60 deg. double vee butt joint of the fixed type (see Figure 15). The test plates were made from hot-rolled, low-carbon steel and all welds were made with $\frac{3}{32}$ in. diameter uncoated electrodes.

The tests were conducted by welding the joint with the procedure under consideration and taking readings of the elongations produced in the center bar with a Berry strain gauge. The data from the strain reading gave a measure of the relative values of the different welding procedures.

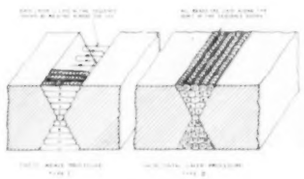


Figure 12.

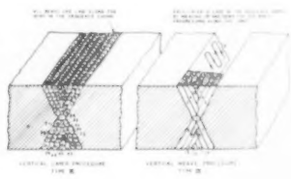


Figure 13.

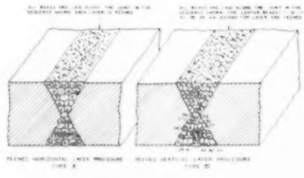


Figure 14.

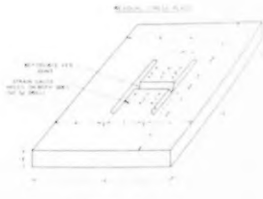


Figure 15.

Comparative data on the relative values of the six welding procedure are given in Table II. These results are computed on the basis of the work done by welding in deforming the center bar of the specimens. This method gave a more accurate method of comparing the different procedures than the direct comparison of the strain readings because nearly all the specimens were stressed beyond their elastic limit.

From these data, it is evident the welding procedure has an important effect on the welding strains obtained and that peening is very effective in relieving such strains. The vertical layer (Type IV) procedure gave by far the most satisfactory results, both for the peened and the not peened procedures.

[6]J. W. Owens, "Fundamentals of Welding," Chap. IX on Residual Stresses.

[7]C. H. Jennings, "The Effect of Welding Procedure on Shrinkage Strains in Butt Welded Joints," Jl. of Amer. Welding Society, April 1931, Vol. 10, No. 4, pp. 27.

[8]C. H. Jennings, "The Relief of Welding Strains by Annealing," Jl. of Amer. Welding Soc., Sept. 1931, Vol. 10, No. 9, pp. 26.

*Paper read before American Welding Society, Chicago Section, Nov. 6, 1931.

†Research Laboratories, Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Pa.

Table II.

Comparative Data on Different Welding Procedures

Welding Procedure	Total work to deform center Bar ft. lb.	% work done as compared to type I procedure
Type I. Cross Weave	116.3	100.0
Type II. Horizontal Layer	131.2	113.0
Type III. Vertical Layer	83.8	72.0
Type IV. Vertical Weave	158.0	136.0
Type V. Peened Horizontal Layer	66.2	57.0
Type VI. Peened Vertical Layer	37.9	32.0

B. Strain Relief by Annealing.

The results of the welding procedure tests indicated that the residual stresses (welding strains) could be greatly reduced by the proper choice of welding procedure, but that they could not be entirely eliminated. For this reason, it was desirable to study the effect of annealing the finished articles to relieve welding strains.

Tests on annealing were made on welded specimens made from hot-rolled steel plates as shown in Figure 16. The tests were conducted by taking strains reading in the bars of the specimens before and after welding and before and after cutting the welds subsequent to their annealing. All strain measurements were taken with a Berry strain gauge.

The strain gauge readings taken before and after welding gave an accurate measure of the initial residual stresses in the specimen resulting from welding. If any stress still remained in the specimens after they were annealed, the cutting of the weld (Figure 16b) relieved this stress. Consequently, the strain readings taken before and after cutting the welds gave a measure of the residual stress remaining in the specimens after annealing.

A series of tests were made by annealing the welded specimens at different annealing temperatures and for

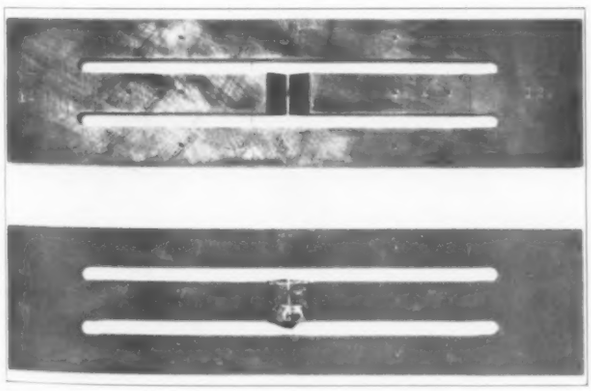


Figure 16. Specimens for Investigation of Strain Annealing.

different soaking times. (The soaking time is the length of time the specimens are held at the annealing temperature.) All annealing was done in a small electric furance which made it possible to heat the specimens to the annealing temperatures in 45 to 60 minutes.

Curves showing the residual stresses remaining in the specimens after annealing, as obtained from different annealing temperatures and soaking times, are shown in Figure 17. Examination of these curves show the following:

1. Welding strains and residual stresses can be reduced by annealing at temperatures below the critical point.

2. The effectiveness of annealing in reducing residual strains depends upon the annealing temperature and the soaking time.

3. In order to obtain a given minimum residual stress, the higher the annealing temperature the shorter the soaking time required.

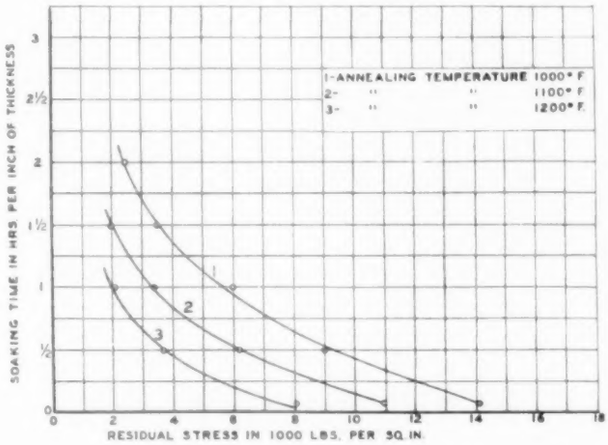


FIG.17:- SOAKING TIME - STRESS CURVE

4. By proper annealing, residual stresses in welded structures can be reduced to a few thousand pounds per square inch.

In connection with these tests, it is well to mention that the specimens were stressed in direct tension and compression. The possibility of obtaining different results with specimens subjected to bending stresses is recognized and will warrant further investigation.

Conclusions

The results of the above work give data on the properties of welds and welded joints and help make possible a sound scientific basis for the design of welded structures.

The fatigue tests discussed furnish the endurance limit of fillet welds and weld metal and give the effect of machined, rough (not machined) and peened surfaces on the fatigue strength.

The work on welding strains shows that the residual stresses in a welded joint depend partly upon the welding procedure employed. The proper choice of welding procedure will greatly reduce the welding strains, but will not completely eliminate them.

In order to reduce welding strains to a minimum value, annealing of the finished article is very effective. Proper annealing is shown to reduce the residual stresses in welded structures to within a few thousand pounds per square inch.

Acknowledgements

The author is indebted to Mr. F. C. Cassel for the operation of the fatigue testing machines, and Mr. R. E. Peterson, manager of the mechanics division, for his valuable assistance and suggestions in connection with this work.

Methods of Controlling Arc Blow

Don't jump at conclusions when the wire or the machine seems to "go bad" all of a sudden. Arc Blow may be the cause of the trouble. In a series of two articles Mr. Holt points out some of the more important causes and several practical and effective remedies.

By R. W. Holt†

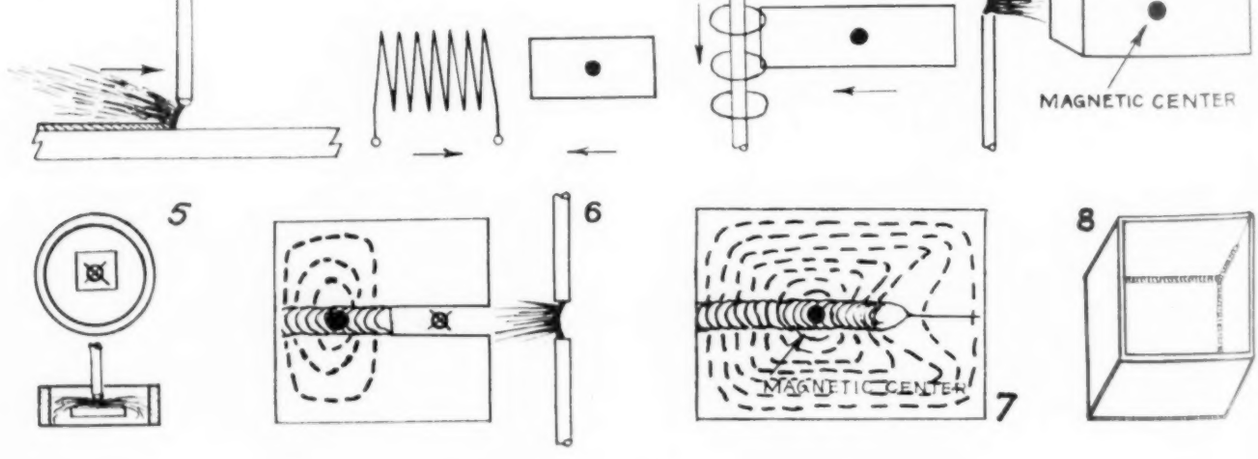
ARC magnetism is the tendency of the arc, after a welder has progressed a few inches down a seam, to move in various directions, generally in the opposite direction to which the welder wishes it to move. This, of course, has to be compensated for and, overcome if the welder is to do efficient work.

What Causes Arc Magnetism or Blow?

To understand the cause of the movement of the arc, or arc magnetism, it is necessary to refer to an ordinary electric current flowing in an ordinary wire or conductor. If a coil carrying a current is placed next to a piece of steel, it is well known that the piece of steel will be attracted to the coil, or tend to move toward the coil and actually inside it. (Figure 2) It must also be remembered that the piece of steel, if held fast, attracts the coil carrying the current. In other words, it is a mutual attraction. The steel will tend to move towards the coil or the coil will tend to move towards the steel, provided the steel be held fast. The final position will be reached when the coil completely surrounds the piece of steel and the geometrical center of the coil coincides with the geometrical center of the piece of steel, marked in Figure 2 with a black dot. Any wire or conductor carrying an electric current is simply part of a coil and obeys the same laws, except the tendency to move may be weaker. There is this difference, however. The coil being hollow allows the movement to be satisfied. In the case of the single conductor, however, due to mechanical difficulties, it is obviously impossible for the conductor to move until this movement is satisfied. In other words, when the single conductor came to rest it would be evenly surrounded by the steel, as near as possible, or in the location shown by the black dot in Figure 3.

The arc is simply a conductor, with this difference. It is free to move to a limited extent. If we draw an arc between two carbons next to a heavy body of steel, the arc, being free to move, will follow the laws of a single conductor or wire carrying a current, and move to the limit of its ability in the same direction that the single conductor tends to move. The two carbons, however, being mechanically held, will not move. For convenience, the point at which a single conductor or an arc theoretically would be at rest, with no tendency to move in any direction, will be called the magnetic center of that particular piece of steel. This spot will be pointed out in pieces of steel of various shapes and kinds.

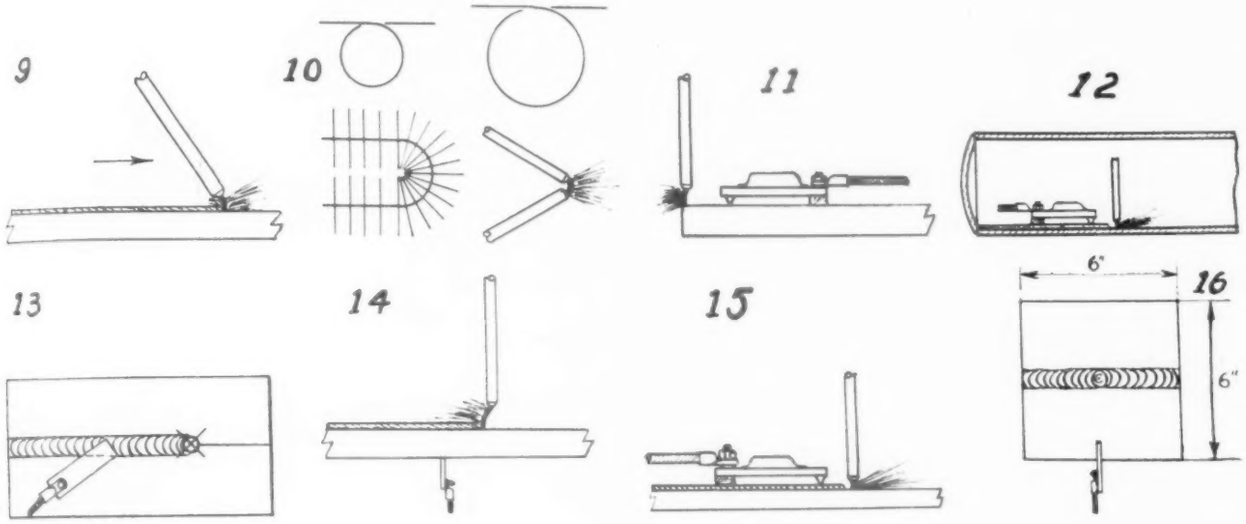
†Research Engineer, Fusion Welding Corporation, Chicago, Ill.



A question that might be raised at this point is, "The foregoing explains why the arc moves, but why does the flame move?" The answer is that not all the current flows directly through the arc center, the part of the arc commonly referred to when the word "arc" is used. The flame of the arc carries its portion of current, and follows the same laws as the single conductor, but, being more free to move than even the arc, consequently moves farther. An experiment which tends to prove that the flame of an arc carries its portion of current is as follows. Take two welding machines, hold the electrode of one machine one-eighth of an inch off the surface of an iron plate. Strike an arc with the electrode of the second machine and manipulate it in such a way that the flame surrounds the point of the electrode of the first machine. This will start the arc of the second machine without the electrode being touched to the plate. This proves that the arc flame is conductive to the electric current, and if it is conductive the laws of resistance determine what portion of current flows through the arc flame.

The next experiment was directed at confirming the foregoing insofar as the arc and its movement is concerned. A very heavy small iron ring, see Figure 5, was chosen, a very small plate placed inside it and an arc was struck on this small plate, in the geometric center of the iron ring. The arc here seems perfectly at rest, the arc flame going evenly in all directions confirming the previous experiments. Not all pieces of iron and steel that are welded, however, are geometrically uniform or even. The magnetic center, as previously referred to, in a non-uniform or geometrically even piece of steel, will be that spot at which the arc can come as near as possible to having an even path for its magnetic line of force.

It follows that in a piece of steel or two pieces of steel partially welded with a wide gap, Figure 6, the magnetic center would be somewhere in the welded portion, provided the two pieces were nearly equal in size. Figure 6 shows such a piece of steel partially welded, being made of two pieces 3 inches wide and 8 inches long, approximately ½ inches thick. The welding being a little over half way. The magnetic center will be approximately 2 inches back from the point where welding was stopped, and the tendency of arc movement will be back towards the welded portion, this being the place where the arc can come, as near as possible, to perfectly surrounding itself with metal for its magnetic lines of force. We have used a wide gap here for purposes of illustration, but the same thing holds true if the plates are placed very close together. If the plates are 3 inches wide, 8 inches long, ½ inch thick, laid edge to edge, and welded for 6 inches, the magnetic center will be a little closer to the point where welding is stopped, approximately 2 inches back from the end of the weld bead, Figure 7. It must be remembered that the unwelded crack however small is still more or less an insulator to magnetic lines of force.



A square box with all but the last corner welded represents a very complicated study in arc magnetism. A question might be asked, "where is the magnetic center or point to which the arc tends to move in such a structure?" (Figure 8) Without going into too much unnecessary detail, it will suffice to be said; the magnetic center, when welding is completed to the point shown, welding to be done on the inside, will be approximately in the center of the bottom. In other words, the point to which the arc tends to move will not be on any of the steel surfaces, but out in the center of the box a little closer to the bottom than the top.

Having discussed arc magnetism from the point of understanding what causes it, the next question follows naturally, how to control it. Hand welding will be considered first.

Control of Arc Magnetism in Hand Welding

The most common control, known to every welder, simply tipping the electrode. This will be found to be particularly effective if the ground is in the rear of the electrode. In other words, the electrode travelling away from the ground while the welding operation is carried on. Sometimes tipping the electrode has no effect, and the operator will generally find that the ground is wrongly placed, i. e., it should be in the rear of the direction of travel of the arc. An explanation of why tipping the electrode forces the arc ahead will be a little complicated. In a conductor shaped in the form of a loop carrying a

current, Figure 10, the lines of force are forced through the inside of the loop and only have so much space through which to travel. On the outside, they have plenty of space through which to travel. There is a force in the small loop tending to enlarge and provide more room for the lines of force that are forced to go through the inside of the loop. The electrode and the current travelling through the parent metal in one sense represent a portion of a loop, and tipping the electrode is simply the same thing as making a smaller loop or congesting the lines of force in behind the arc, and the movement of the arc is simply the same as the natural tendency of a conductor to move in such a manner as to provide more room for the lines of force that are congested behind it. This is better illustrated by taking two carbons and pointing them in such a manner that an arc is drawn in the effect of a "V." It will not take much imagination to see that the lines of force are congested on the inside of the "V" and that the carbon and arc are simply part of a loop, illustrated to the left of the loop in Figure 10, and that the arc in this case is following the natural laws of a conductor carrying electricity, moving in such a manner as to provide more space for the congested lines of force. This method of control, while a very convenient one, is relatively very weak, especially if the ground is in the wrong position. The ground, on the other hand, is a relatively strong method of controlling the arc flow, but is not so convenient to use effectively. In ordinary cases of welding, where there is not bad magnetism, the ground is just connected on to the work at the best point, sometimes five or six feet or more away from the place where the arc is working. If, however, the ground be brought up to within a foot or so of the arc, in some cases as close as 6 in., and connected to the work, it forms a very effective means of controlling arc magnetism or blow, especially where arc magnetism or blow is very bad. The usual mistake in controlling arc magnetism or blow by the ground is placing the ground too far away from the arc. It should be placed quite close to be a strong control. There is a common law to be observed in using the ground, and it is, the ground always pushes the arc. If this is remembered, it is a relatively simple matter to correct arc blow by using the ground.

A good form of ground for general use is an iron plate ⅜ in. thick, 3 in. wide and approximately 9 or 10 in. long, having three legs ¾ in. long and a handle on top for handling. The back two legs should be insulated in such a manner that no current can flow through them, forcing all the current through the one single leg at the front of the iron plate, so that this leg can be placed, if necessary, very close to the arc, effecting a very strong control. See Figure 12.

A very bad case of arc blow is generally found in vessels of a bell shape, such as a tank with one end welded. If a horizontal seam is attempted in this case, especially on the inside of the tank, a very bad case of arc blow will generally be found. Figure 12 shows such a case with the ground being used to urge the arc along the seam. The smaller the vessel, as a rule, the stronger the arc magnetism. A small container, about 8 in. deep, 8 in. in diameter, with one end welded, made of ⅜ in. iron, represents about as mean a case as could be found, if the lengthwise seam is attempted from the inside from the welded end up.

Every welder knows the very strong tendency of the arc to run towards the center of a sheet or away from the edge, when starting a longitudinal seam such as the longitudinal seam of a tank without the heads welded in. The tendency of the arc to run away from the edge is very bad in this case, and if the ground is used correctly it can be used to not only neutralize it, but if necessary, to completely reverse this tendency. Using the ground to such an extent that it completely reversed the blow of the arc would never be done in practice and only illustrates the effect of the ground, Figure 11.

To overcome the arc blow on the edge of a sheet or shell of any size, the ground contact should be on the seam, possibly between 3 in. and 18 in. from the arc. While the ground with a handle on it made of a flat plate with three points, two of the back ones insulated, is very convenient on flat objects, it is not so convenient if the welding is in an odd position or on an irregularly shaped object. In these cases, a ground made of a strip of steel approximately ⅜ in. thick, 1½ in. wide and 8 in. or 9 in. long is very convenient, the cable being bolted on to one end, Figure 13. When working on vertical, uphill and odd shaped surfaces, this ground can be tacked to the object in question, and, in unusual cases, held in the left hand and manipulated approximately 5 in. or 6 in. back of the arc, or in such a position as regards the arc to completely neutralize its blow, always remembering that the ground pushes the arc when on the same side of the sheet or object as the arc.

The ground on the opposite side of the sheet, Figure 14, or object, is not so satisfactory as a rule and its effect is considerably weaker and not always in the same direction as when it is used on the same side of the sheet or object as the arc. The best results are secured by keeping the ground on the same side of the sheet or object as the arc, Figure 15.

In most cases, a position can be found for the ground where it can be left more or less permanently, while the welding in question is being carried out. Some cases, however, will require a little study and experimentation to find the best place. Take for instance the problem of welding two flat plates together 4 in. wide, 9 in. long and approximately ⅜ in. thick. The best place for the ground, under these conditions, is approximately 3 in. to 4 in. away from the weld and in the center of one plate, Figure 16. There will be some magnetism at the edges, but not enough to bother when welding is carried out from one side clear across to the other side, and if welding is carried from each edge toward the center, Figure 16, there will be scarcely any.

(To be continued)

Ohio State Welding Conference Draws Good Attendance

The first welding conference sponsored by the Department of Industrial Engineering of The Ohio State University held in Columbus, February 25-26 drew a gratifying number from the surrounding territory to hear papers detailing the new developments in welding and to see the exhibits of new equipment that were on display.

The two-day session was opened by G. W. Rightmire, President of the university who was followed by E. A.

Hitchcock, engineering dean and John Younger, Chairman of the Department of Industrial Engineering.

The following is a list of the papers presented at the meetings:

"Construction of Welded Machine Bases." E. W. P. Smith, Consulting Engineer, The Lincoln Electric Co.

"Theory and Practice of Oxyacetylene Cutting." W. H. Ludington, Field Engineer, The Air Reduction Sales Co.

"Welding in Railroad Shops." Clay Roberts, Welding Engineer, Pennsylvania Railroad.

"Spot, Seam, Butt, and Projection Welding," illustrated. M. L. Eckman, Research Engineer, The Federal Machine and Welder Co.

"Welding Overland Pipe Lines by the Lindeweld Process," illustrated with Motion Picture Films. W. S. Walker, Development Engineer, Linde Air Products Co.

"Fatigue and Tensile Tests of Welds and the Relief of Residual Stresses." Charles H. Jennings, Research Engineer, The Westinghouse Electric and Manufacturing Co.

"The Welding of Copper and Copper Alloys." W. C. Swift, Service Engineer, The American Brass Co.

Short Talks: "Hard Surfacing." W. A. Moore, Haynes Stellite Co. "Welding of Stainless Steel," Republic Steel Corporation.

"Arc Welding of Steel Buildings and in Manufacturing." J. G. Ritter, Welding Engineer, The Westinghouse Electric and Manufacturing Co.

"Arc Welding." H. J. Babcock, Industrial Welding Specialist, The General Electric Co.

"The Use of Stock Fittings for Welded Piping." H. J. Bartlett, The Crane Co.

Economies Obtainable by Welding in Structural Fabrication

By Alexander L. Wilson†

WHETHER or not there is a saving that can be effected by welding structural steel is a question upon which there is a great divergence of opinion. The cost of welding in any one shop will vary from the cost in other shops depending on the planning of the work. The training of an organization to take advantage of all possible savings is a matter of growth and development. To assume a saving of 10 per cent by the use of welding, because some other shop after years of study and experience is able to make such a saving in certain cases, is an assumption that may prove unprofitable. This paper attempts to set forth various factors affecting the cost of welding from which you may develop the costs in your own shop.

The present tendency is away from quantity of weld and toward quality. If you are to take advantage of this you must be sure that the welds put on will develop the estimated strength. This requires qualified welders, trained inspection, and proper location of the welds. These are not hard to obtain. But do not forget that after a building has fallen in on a man it will take a good salesman to sell him another welded building.

How are you going to know whether it will be cheaper to weld than to rivet? This question is asked of production men and an opinion required immediately. Certain fundamental premises have to be considered together with the unique features of the job.

For example:

1. If the steel can be cut to length and sent directly to the welding floor without being marked, punched, bolted or riveted you can save money by welding.
2. If a piece can be marked and punched and welded completely without going to the bolt up or rivet floor you can, in a good many cases, save money by welding.
3. If a piece requires both welding and riveting you may lose money by welding certain parts only, although these parts may in themselves be welded advantageously.
4. If a piece is to be welded there must be some method devised to hold it in position economically.

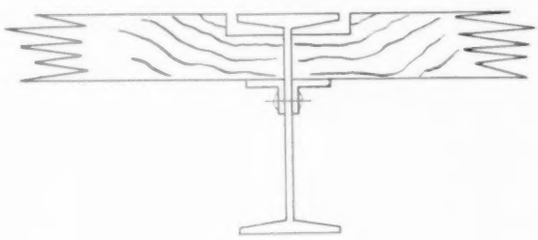


Fig 2

As an example of the first case mentioned above we have plate and beam lintels. Welding eliminates the marking and punching as well as the driving and chipping of rivets. Columns for small buildings can have welded cap and base plates, splice plates, and seat angles for beams, eliminating all punching with the exception of details. Welded cap and base plates for columns are a good example of welding economies offset by the increased fitup

†*Mississippi Valley Structural Steel Co., Chicago.*

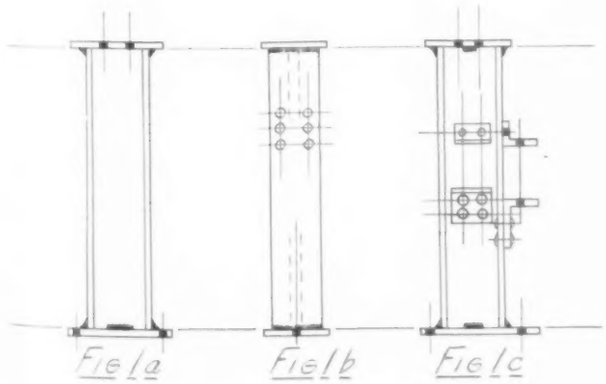


Fig 1a Fig 1b Fig 1c

required. If the H-sections are rough cut or burned on the ends the time required to square the plates and hold them from drawing while welding will be a decided handicap to welding. However, if the sections are milled or sawed square the time required to weld cap and base plates will be very small. (Fig. 1-a.)

FIG 3a

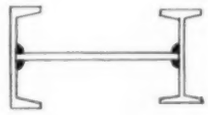


FIG 3b

Now suppose that we have a column with a beam framing into the flange. This requires punching. We can however economically weld the base and cap plates as no bolting or riveting is required. (Fig. 1-b.) But on the other hand if we were to rivet some clips on the column we might better punch a few more holes and rivet on the base material. (Fig. 1-c.)

The chief difficulty in welding is to hold the pieces in position while you weld them. If you only have one or two pieces requiring clips or plates welded at a bevel it is hard to clamp them on without the pieces slipping while tightening the clamps. Then they have to be hammered back into place before welding. In the end it costs more than to punch a few holes and bolt and rivet them. If you have a quantity you can weld clips to a table or welding floor or use movable clamps to locate your material. The clamping of pieces together is one of the chief factors to be considered before deciding on welding.

As a simple case, take the beam in Fig. 2. It has shelf angles for floor joists. We will say that it is wall bearing, the shelf angles being the only shapes connecting to the beam. The main objection to welding this piece is in holding the angles tightly against the web while welding.

Then, too, you can only weld one side of the beam at a time and you have to turn the piece over to weld the other angle. In this case it would be cheaper to rivet the angles on.

II

THERE ARE THREE fundamental economies in design.

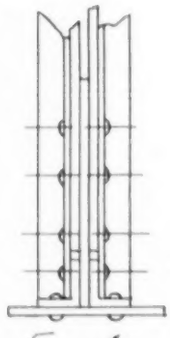


FIG 4a

FIG 4b

1. In tension members you do not have to deduct for the holes.
2. The elimination of connecting members.
3. The elimination of non-working areas.

The first is well understood. But in a good many cases not much heed is paid to it. The stand often taken is that one hole cannot cut out much material and if welding saves that little the structure will be that much stronger. Let me call your attention to a simple case. Suppose that you require 1.5 sq. in. of area in an angle. If you took out one $\frac{13}{16}$ in. hole you would have to deduct .25 sq. in. from $\frac{5}{16}$ in. metal.

Size	Wt.	Area	Deduct for Hole	Net Area	Saving
3x3x$\frac{5}{16}$	6.1 lb./ft.	1.78	.25	1.53 sq. in.	0
3x2x$\frac{5}{16}$	5.3	1.55	0	1.55	13$\frac{5}{8}$
3$\frac{1}{2}$x3x$\frac{1}{4}$	5.4	1.56	0	1.56	12$\frac{1}{2}$

In the case of riveted trusses gussets are required to fasten the members together.

When a truss is welded the members are welded directly to each other. This eliminates considerable weight and effects an appreciable saving in small trusses. In trusses over 65 ft. the saving is not so pronounced.

One of the major savings of material obtained by welding is through the elimination of non-working areas of steel. In a fabricated piece of steel certain areas carry the stress and certain other areas connect the stressed areas together. These connection areas which I speak of

FIG 5a

FIG 5b

as non-working areas can be greatly reduced by welding.

In Fig. 3, a part of the flange angle area is utilized for strength, but part of it is merely to connect the flanges to the web. This part can be eliminated by welding the flanges directly to the web as shown in Fig. 3-b. In Fig. 4-b is shown the reduction of non-working metal as compared to the riveted design in Fig. 4-a. In the welded design the flanges are welded to the web plate and bars are welded to the web and flanges as stiffeners. In Fig. 5-a and Fig. 5-b we again do away with one leg of the stiffening angle which is required to fasten the other or working leg onto the channel. Also in the case of the sash angle we do away with about half of the outstanding leg which was used to fasten the downstanding leg of the angle to the channel.

III

In considering the possible economies from a standpoint of shop costs there are two factors that are often lost sight of in making a comparison. Most shops doing both welding and riveting are laid out and equipped to do the riveting in the most efficient manner.

The welding is done at odd points where it does not interfere with the riveting. But in considering the saving possible by welding, a shop designed for welding should be considered.

In welding not much punch space is required, but considerable room must be provided for fitting and welding. There must be enough work fitted ahead to avoid welding delays. The welding can be done by semi-automatic machines carried on overhead travellers so that they can be moved from piece to piece without loss of time. Plate and beam lintels and sections as shown in Fig. 3-b and Fig. 4-b have been welded on full automatic machines

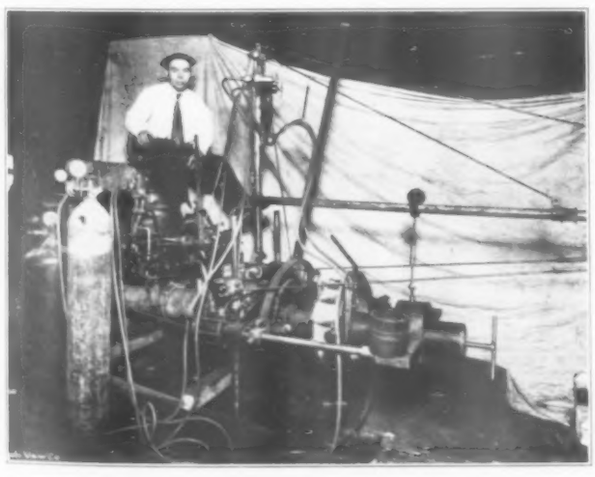
which weld the steel together as our mothers used to sew cloth on a sewing machine.

A true comparison of cost cannot be arrived at when comparing the cost per pound of welded steel with the cost per pound of riveted steel. Welded steel will weigh from a seventh to an eighth less. Even if the cost were the same per hundrd pounds you would have a saving of 10 to 12 per cent per unit.

Gas Welds 6-Inch Pipe in 50 Seconds

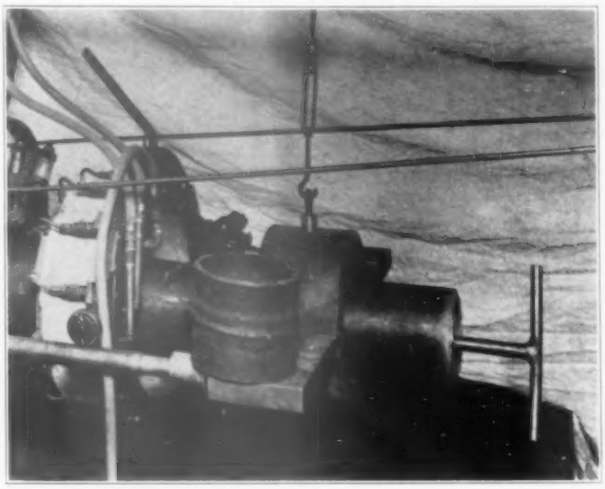
THE possibility of building resistance welders to make butt welds in pipe lines in the field has been the subject of a little informal discussion and of some speculation during recent years when so much attention has been given to the rapid production of pipe joints, but so far no machine for doing the job has made its appearance. The nearest thing to it is a machine which has been developed during the past year by C. L. Meinholdt, President of the Topeka Arc Welding Company, Topeka, Kansas. This firm specializes in pipe line contracting but gives a complete welding service including tank construction, boiler welding, structural work, automobile repairs, railroad repairing, etc. The shop is equipped for both gas and electric welding.

The new pipe welding machine is built for welding pipe in the field and is designed to travel under its own power along the pipe line from one weld to another. The pipe is bevelled about the same as it is for ordinary gas welding except that the angle of bevel is less. The ends are raised to a welding temperature by means of a



New Oxy-Acetylene Pipe Welding Machine for Field Work.

series of oxy-acetylene torches equally spaced about the pipe on what is called the "firing ring." This ring is oscillated about the pipe until the edges are brought up to the melting temperature; then the pipe ends are pulled together by a hydraulic press, pumps being located on each side of the machine and operated by a small four-cylinder engine. An expanding mandrel is used to hold the pipe in line while the weld is being made. After the weld is completed, this mandrel is loosened and removed.



Close-Up of the Welding Unit with a Sample Weld Shown in the Foreground.

There is a boom mounted on the machine to lift the pipe in place and hold it there while the mandrel is being adjusted. No filler rod is used in making the welds. The procedure is simply to use the torch flames to get the pipe ends in a molten condition, and then squeeze them together quickly—that is, it is a heat and squeeze operation, the movement of the torch flames is for the purpose of distributing the heat evenly around the circumference of the joint so that the melting will be as uniform as possible.

Mr. Meinholdt states that a number of welds have been made with this machine on 6-inch pipe with an average time of one minute per joint—the shortest time on one joint being 50 seconds.

This machine is such a recent development that there has not been time for extensive investigations of the joints produced on the machine, but the preliminary experiments with it indicate that it at least has interesting possibilities in the direction of fast production. It is to be expected that the welds made by it will exhibit different qualities as compared to welds made by other procedures. The investigations of pressure welding recently made by C. R. Austin and W. S. Jeffries are of considerable interest in connection with this process, indicating as they do that the quality of a pressure weld is affected strongly by film interference when any oxide film is present. This process would seem to offer two methods of preventing the possible bad effect of an interference film. In the first place, the protective envelope of the oxy-acetylene flame serves to discourage the formation of oxides, and, second, the squeezing operation may force all of the surface material out of the weld, leaving a joint practically free from oxides.

While pipe line welding is apparently an ideal application for this heat and squeeze type of oxy-acetylene welding machine, it is quite likely that after it has been developed to the point of complete success there will be found other equally interesting applications of the same fundamental principle.

Controlling the Speed of Spot and Seam Welding

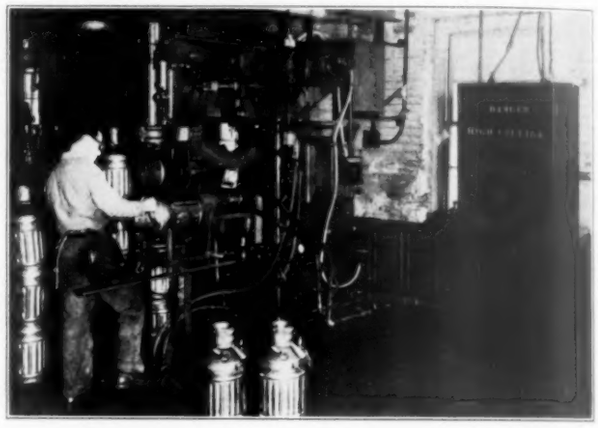
CLOSE and accurate control of the frequency of current interruption in line welding, and an increase in speed of interruption up to 1800 per minute, are among the advantages of a new type of Thyratron tube timing control announced by the General Electric Company. The new control replaces mechanical interrupters.

The equipment operates in synchronism with the alternating current supply of the welding machine. The weld is always started at a predetermined point in the voltage wave and stopped when the current passes through zero. Thus the period of current application can be accurately controlled even with "on" times of but one or two cycles.

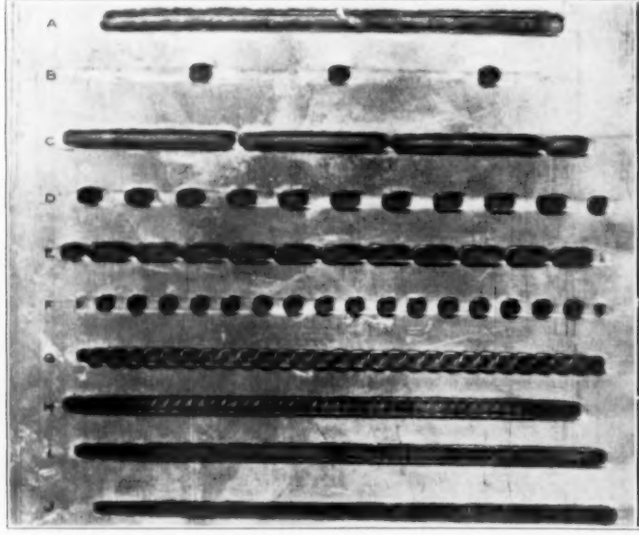
The new synchronous tube timer supplements, and is designed to work in conjunction with, the General Electric welding control type CR 7503 recently announced which uses Thyratron tubes instead of contactors for interrupting the flow of current. By a combination of the two equipments, a very close degree of accuracy and a high welding speed are obtained.

The control embodies a series transformer the primary of which is connected in series with the primary of the welding transformer and the secondary of which is short circuited by two Thyratron tubes connected thereto. Welding current will not flow unless the grids of these tubes are properly energized. For controlling and energizing the grids of these Thyratrons three small Thyratron tubes are used. One in combination with a condenser acts as a timer. This timing Thyratron trips when the condenser is charged to a certain point and controls the grids of the other two small Thyratrons which, in turn, control the two power Thyratrons. The control has no moving parts and is subject to no such wear as is involved in mechanical interrupters.

An installation of the new tube control equipment has already been made at the plant of George D. Ellis & Sons, Inc., of Philadelphia, in connection with the manufacture of oil cans. The side, top, and bottom seams are welded by intermittent line welding. Very satisfactory results have been obtained, the Ellis Company reporting that it is consistently obtaining much better and more uniform welds than they have been able to secure through the use of a number of different types of mechanical interrupter. After the cans are welded they are subjected to a compressed air test of eight pounds pressure for leakage while submerged in water. Production has been speeded up and a uniform product also results. This has decreased the number of can that had to be rejected to a minimum and has greatly reduced the time required for testing the cans.

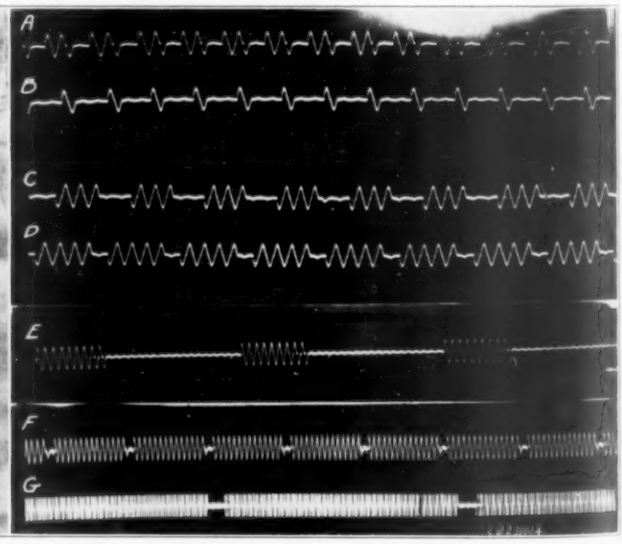


Line Welding Milk Cans on Thyratron-Tube Controlled Welder.



Resistance Welds Made at Approximately Seven Feet Per Minute on Tube-Controlled Line Welder.

A—21 Spots per Inch. *B*—Long Off Period, Short On Period. *C*—Short Off Period, Long On Period. *D*—Intermediate Speed and Ratio. *E*—Intermediate Speed and Ratio. *F*—1⅝ Spots per Inch. *G*—3 Spots per Inch. *H*—4½ Spots per Inch. *I*—6 Spots per Inch. *J*—14 Spots per Inch.



Oscillograms Showing Range of Control Obtainable with Tube-Controlled Resistance Welders.

A—2 Cycles On, 1 Cycle Off. *B*—1 Cycle On, 2 Cycles Off. *C*—3 Cycles On, 2 Cycles Off. *D*—4 Cycles On, 1 Cycle Off. *E*—9 Cycles On, 19 Cycles Off. *F*—13 Cycles On, 2 Cycles Off. *G*—97 Cycles On, 7 Cycles Off.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

Brazing Copper Under Water Offers No Difficulties

By L. Steffey*

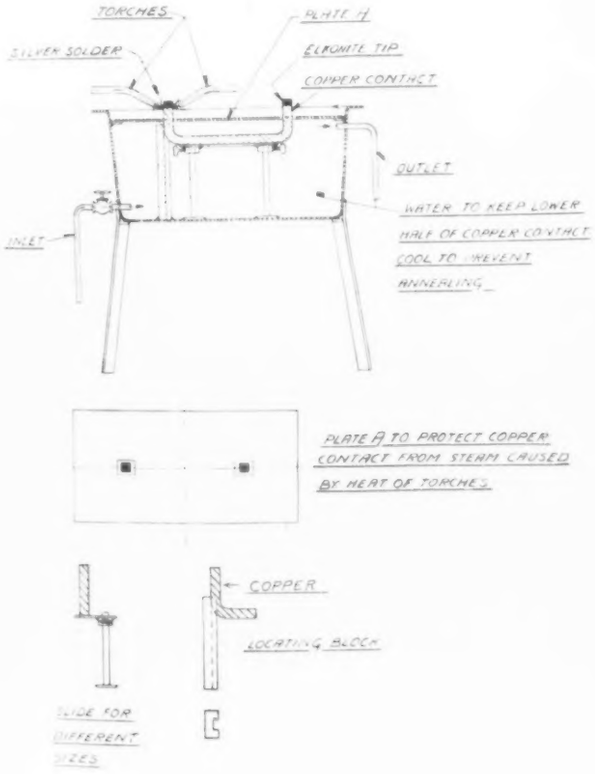
The problem of brazing Elkonite tips to a hard roll copper contact arm without affecting the hardness of the copper has been solved by the Switchgear Department of the Westinghouse Electric and Mfg. Co. by brazing under water. The solution is described herewith.

A sheet iron tank was made having a pipe connection welded at the bottom of one end of the tank and, also, a connection welded on the opposite side of the tank at the top. The pipe at the bottom was connected to a water line with a shut-off valve outside the tank to control the flow of water and to shut off the water when not in use. The pipe on the opposite side of the tank served as an overflow to carry the water away.

A holding fixture is used inside the tank for holding the contact arm in position. The fixture is provided with adjustable arms and can be adjusted for different sizes of work. A steel plate is used for a lid or covering, which has openings cut into it the size of the copper piece to be brazed and is placed on top of the tank. The copper contact projects through the opening in the top plate just far enough to allow Elkonite pieces to be brazed to it. The valve on the water line is opened and water allowed to flow through the tank with the water level being up to the bottom of the cover plate. A steady flow of cool water through the tank keeps the part of the copper arm that is immersed in water from becoming hot and also tends to keep the copper end cool that is being brazed, but does not cool it enough to interfere with a good braze. Thus, the tip that is being brazed is the only part actually affected by the heat of the torch.

This brazing, however, is done by men experienced on this line of work, two torches being used simultaneously. This brings the surface that is to be brazed to the proper heat very rapidly and makes a very satisfactory job. Tests show that the hardness of copper has not been affected in any manner, while being brazed.

*Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.



Technique of Welding Automobile Spring Leaves

By N. W. Brelsford

The leaves of automobile springs being of high carbon steel, should be welded with the addition of as little filler rod as possible, only enough being used to compensate for that part ground away in polishing, in the preparation of the parts. It is desired to have the finished weld, as near as will permit, the same consistency as the metal on either side. The puddle being started, the weld should be completed without interruption, taking care to keep the metal just above the fusion point, never allowing it to reach a temperature high enough to emit sparks or bubbles. (This should be guarded against in spring welding to a greater degree than any other metal for the nature of this steel will not permit of its being burnt.)

Preparation. It has been found that welds to be made in spring steel must be free of all foreign matter. It is therefore necessary to have the joint or ends to be welded as clean as possible. This may be effected by grinding or polishing. By grinding the break square or so the break may be placed in a position to weld without bevelling, it will be found that a very small amount of filler rod is required to complete the weld, since at this point the parts should be separated approximately one-sixteenth of an inch.

A welding tip one size larger than commonly used on

metal one-quarter inch in thickness should be used, employing a perfectly neutral soft flame.

The welding rod should be a one-eighth inch welding rod of Norway iron or mild steel. It will be found that this size rod is readily manipulated in a small puddle, since the rod is to be used to work the metal rather than to add metal to the weld, only enough of the rod being used to compensate for the metal used in the fusion process.

Welding. By preheating the metal a more uniform and much faster weld may be executed. As soon as the preheating has been effected the weld may start, employing the backward method with no torch movement, using the rod for manipulation, constantly working the metal and taking care to work out all bubbles and foamy particles. The weld may be completed in one operation, or reversed working out any pin holes or uneven surfaces that may appear on the opposite side. The backward method of welding is preferable, since the flame prevents the entrance of undesirable gases.

Heat Treatment. The heat treatment of a weld in spring steel has much to do with the restoration of the metal. When the weld is completed it will still be at a temperature of 1400 degrees F. or more, its color being a bright cherry to a distance of approximately three-quarters of an inch on either side of the weld. The flame must now be turned back on the metal, beginning well within the colored portion, to bring the temperature up, and extending to a distance of six or eight inches on either side of the weld. By manipulation of the torch let the heat graduate until no color shows at a distance of five inches from the weld, not letting the cone of the flame come in contact with the metal.

By a series of tests on welded spring leaves before being heat treated, it was found that a zone of cleavage, or breaking point always occurred approximately two inches on either side of the weld. This critical zone was found between the highly heated portion and the lower temperature of the unheated parts. By extending this zone through an even graduation to a lower temperature over a distance of several inches, it was found that the critical zone disappeared.

After experimenting with the above method of welding spring leaves over a period of several months it was found that no welded leaves were broken after replacement in automobile springs, other leaves having broken in springs where welded leaves were installed.

Patching Pipe Lines Is Not Difficult

By W. E. Archer

Some difficulty has been experienced among welders in successfully welding a patch over a pit hole in a trunk pipe line with oil standing in the line.

Such a job, while not considered practical by many not familiar with such work, is usually a relatively simple task, circumstances and working conditions, of course, altering precise methods and procedure to be employed.

One common method is to use a sleeve made from a larger diameter pipe. For example, in repairing a 12-inch pipe, use a 14-inch piece of pipe for the repair sleeve. Such a sleeve is made by taking a section of the larger size pipe of the required length and splitting it longitudinally with the cutting torch into two equal size pieces. With the torch, the edges are then trimmed and beveled properly to fit snugly over the area of the line to be patched. The longitudinal seams are then tacked and welded, and both ends of the sleeve welded solid to the smaller pipe, forming a complete fluid-tight patch.

Another method may well be mentioned,—one that is considered by some oil field welders to be more simple. The procedure followed consists in first shutting off the flow of oil through the line, and then cutting out the section of the pitted pipe. While the open ends of the lines are plugged by stuffing them with mud or some similar substance, a new section of pipe of the same length and diameter as that of the piece removed, is prepared and welded into place. This job is also successfully handled by the electric arc process.

Alignment Jig for Pipe Welders

By S. H. Jones†

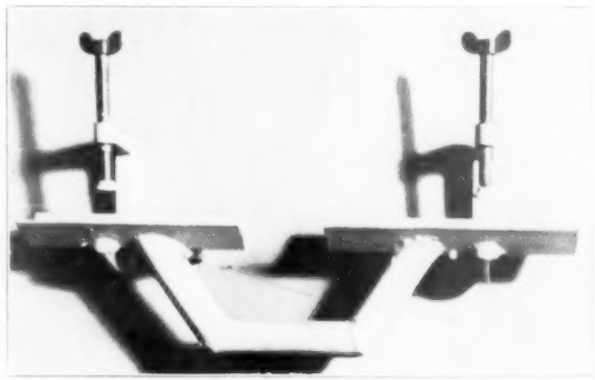
The construction of this tool is very simple and it is easy to make. The material required consists of—

1—Piece of Angle Iron of suitable dimensions, for instance 2½x2½, 30″ long.

1—Piece of light tubing of similar length.

2—6″ "C" Clamps.

The tubing is cut or bent in a "U" shape; the ends are shaped so as to straddle the angle of the angle iron and welded to same, care having been taken in placing so as to divide the end spaces equally.



An Easily Made Jig Which Assures Perfect Alignment When Making Pipe Welds.

The "C" clamps are then brazed into position at the ends of the angle so that the screw will form a clamp such as will hold pipe between the flanges of the angle and the point of the screw.

With clamps so attached use your cutting torch to remove a section of the angle iron at the center. You now have a tool that you may clamp to the end of one piece of pipe with one of the screws and bring into position the other length you wish to weld, using the second screw to hold this piece.

This instrument will be found of great assistance in your pipe work and also on other jobs where the problem of correct alignment has caused you much trouble in the past.

†*Burdett Oxygen Co., Atlanta, Ga.*

Building a Job Welding Business

By W. Irving Brockson

X—Financing the Business (Concluded)

Establishing Credit with Sources of Supply

IF it is impossible to buy initial equipment on a cash basis, it will naturally be necessary to make satisfactory arrangements with each individual welding machine manufacturer, supply dealer, etc. Some of these will pass judgment on you in a personal interview, others will ask for business and character references and still others will request you to fill out a financial statement. As in dealing with your banker, it is desirable to give your sources of supply fully and frankly the information they ask.

Furthermore, if you give any persons or business houses as references it is good policy to inform them either in advance or as soon after as possible. The object of this is not to ask them to give you a better recommendation than you deserve, but to show them you appreciate the favor they are doing for you. It is also a good idea to tell them something about the proposed transaction with the firm that may inquire about you. This will enable your references to give a more intelligent reply to the inquiry. Your banker will be one of the sources to which your supplier will give most attention.

Keeping Your Credit Good. It is one thing to get credit in the first place and quite another to keep it good. There are several things the shop owner can do to keep his credit good, among which are: (1) live up to your agreements with your banker to the letter and keep him sold on the future of your business, (2) meet the payments—if there be any—on your equipment as specified at the outset, (3) don't allow accounts of any sort to become overdue, (4) discount your bills if at all possible, (5) build up your reputation every place you can for being honest to the penny in all financial matters. It is important to bear in mind that many companies when seeking the services of a job welder investigate not only reputation and ability along technical and practical welding lines but financial reliability, or credit standing, as well.

Relation of Personal Habits to Credit Standing. It is surprising to learn the great numbers of people who underestimate the influence which their personal conduct has upon their business credit rating. If it is kept in mind that bankers, manufacturers, jobbers, credit agencies and the like are interested first, in your *ability to pay* the debts you now have and those you may reasonably be expected to contract in the future and, second, in the fact that your ability to pay depends upon your *producing capacity*. And by producing capacity in this sense is meant not only your ability to weld a seam but also to supervise your help, to get an increasing volume of work and generally to conduct your business at a profit.

The man who is lazy will not do as much personal welding or get as much new business as the hustler. The "rum hound" cannot be depended upon to be on the job regularly and consequently is likely to lose important trade. The man whose home life is in a turmoil will be worried and upset when on the job. The chronic gambler, whether it be horse races, dice or "red dog" will have a tendency to carry out this chance taking instinct in his financial affairs. All of these things influence the shop owner's *business producing capacity* and are checked up by those interested in extending credit.

Discounting Bills. The matter of discounting bills has been mentioned from the standpoint of keeping one's credit good. It has a further important aspect, namely that of saving money and increasing net profits. Discounts on commodities the welding shop has to buy vary greatly, but mostly range from ½ of 1% to 5% for cash within certain specified times. It can readily be appreciated how this saving counts up if all bills are discounted every month.

Avoid Too Rapid Expansion. The great tendency of the business which is highly successful at the first or during any short period of time in its history is to overexpand.

For example, here is a shop that has operated for several years with just two outfits, one gas and the other electric. After a time these machines became a bit crowded and it is difficult to turn out all the work on them. The shop owner decides in a moment of enthusiasm to buy another electric machine. After it has been in the shop for a month or two he figures up and finds that it has been in actual operation for just one day out of the week. He has his money tied up in an outfit which is not paying its way.

It is true that future operations can never be accurately forecast but the shop operators who have made money year in and year out have studied their average production over a period of months and also have surveyed as carefully as possible what the prospects were for keeping new equipment continuously busy before they bought any. They have known as accurately as is humanly possible just where the extra work was coming from. They have found it better business to work overtime with old equipment and to cut corners in numerous ways than to over equip themselves and have to feed a "White Elephant."

It is said that one of the principal ills of many lines of manufacturing today, such as automobiles, steel and furniture, is that they are over equipped. In other words, probably one half the plants in these lines could turn out sufficient units to supply normal demand. This overequipment is the cause of cut prices, unsatisfactory profits in many quarters, and unsettled trade conditions.

Set up a Reserve. "Save up something for a rainy day." This would no doubt be the "parting shot" which the nine Old Timers mentioned at the beginning of this chapter, would give a "bright young welder" about to embark on his own enterprise. Just as it is necessary for a man in his personal affairs to build up savings, so it is with a business. As far back as the records of commerce go there have been "ups and downs," periods of prosperity and depression, and the same holds true of individual companies. The best authorities on economics agree that during the times a company is making money it should not take out all the profits but should keep a

share of them in a surplus or reserve fund to use in case of emergency. In times of depression the first concerns to fail are those with little or no reserve capital. Those which do have an ample reserve fund are able to operate at a loss for months and even years during "hard times" and be in a position to make money again when conditions improve.

Brazed Copper Water Tanks

IN the erection of the Field Building now under construction in Chicago, only the finest materials are being used and so installed that the tenants who will occupy the structure on its completion will have every convenience that it is possible to provide.

Since the ordinary main pressure is at times insufficient to give a good flow of water in multi-story buildings, provision has been made for the installation of tanks at points where a supply of water will be on hand at all times to make up for loss of pressure in the mains.

In line with the specification of other units in the structure, these tanks had to be of quality material and in addition, on account of the fact that they were to be installed in such a way that they would not be accessible for repair, it was essential that once installed they would last for the life of the building itself. It was decided, therefore, that they be constructed of copper.

The order was given to the Acme Coppersmithing Co., 1427 Augusta Blvd., Chicago, for the construction of a tank 42 in. in diameter by 96 in. high with an approximate capacity of 576 gallons. The thickness of the plate was specified to be ¼-in. electrolytic copper and so joined as to be leakproof. It has long been the practice of the Acme company, which makes a specialty of copper tanks and kettles to braze the joints of the units they manufacture.

The method of designing the longitudinal joint for brazing is of interest and is prepared as follows:

After the sheet has been cut and squared to the proper dimensions, notches 3 in. long and ¾ in. deep are cut along the edges which will form the longitudinal seam. After rolling, these notches are dovetailed together as shown in Figure 1. Since it is necessary to provide a joint that will not permit the molten brazing material to run through, each overlapped section is hammered down until it gives a smooth surface both inside and out. This operation requires considerable skill which is gained only from much experience. At times even an experienced coppersmith will find that the edges will not fit snugly together. When such is the case, small rivets are inserted at each corner of the overlap.

The next operation is brazing the joint. Brass spelter

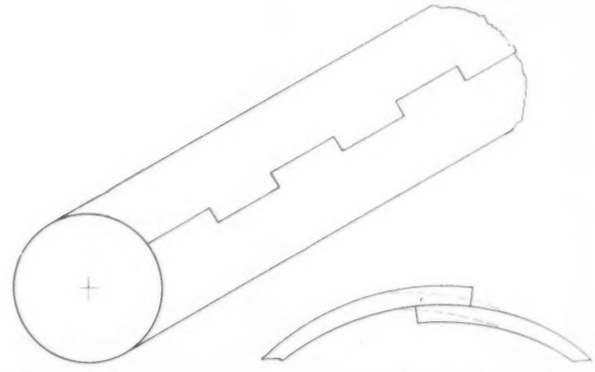
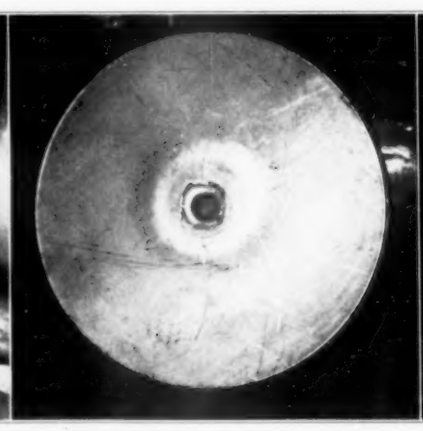


Figure 1. Sketch Indicates How Seam Is Dovetailed. The Overlapped Sections Are Hammered Down as Shown in the Insert.

is used and because good appearance is essential, just the right amount must be applied, and exactly on the seam. In positioning the shell, it is hung on a pipe or other support on which it is free to move with the seam at the bottom. A little water is poured in the bottom and when the puddle spreads evenly over the joint it is in the proper position. If the puddle is seen to be more on one side than the other, the shell is moved slightly on its support until it is in the proper position.

Since copper is a rapid conductor of heat, it was necessary to preheat the seam with two city gas flames to bring the metal to the proper brazing temperature. When a uniform heat was reached the spelter was applied, melted with a Torchweld No. 7 torch using city gas and oxygen. A section of the finished seam is shown in Figure 2. It

(*Continued on Page 59*)



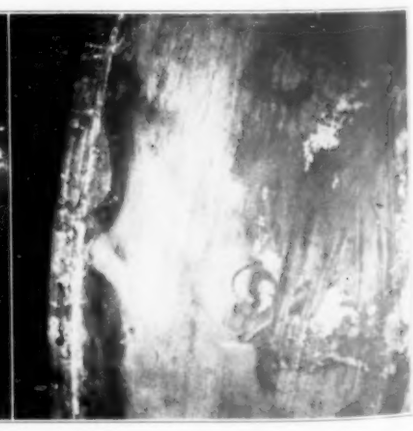


Figure 2 (Left) A Portion of the Finished Longitudinal Seam. Figure 3. (Center) Flanged Head. Figure 4. (Right) Brazed Head-to-Shell Joint.

Prof. Hollister Describes Stresses in Welded Joints

At a meeting of the Western Society of Engineers, Chicago, which was held Monday evening, January 25th, Prof. S. C. Hollister, of Purdue University, presented a paper on "Locating the Stresses in Welded Structural Connections."

Professor Hollister has constructed about a dozen models of typical welded structural steel frames out of celluloid. These models include practically all of the standard connections employed in ordinary building as designed to make use of wedling instead of riveting. By projecting polarized light through these models he is able to show the location and degree of stress in each part of the structure. This makes use of a well-known principle in physics that the transmission and diffraction of light through a transparent material are altered by the stress imposed upon it.

Professor Hollister exhibited his models at this meeting, projecting the images on the screen. They are exact reproductions as proposed for welding. When he applies the load to these models the rainbows show the exact location and comparative amount of stress in each part of the structure, particularly in the welded joint which is the point under study.

For the sake of comparing welded and riveted joints, Professor Hollister has included a few of the latter in his models, so as to show how the stresses are concentrated in the neighborhood of the rivets.

A number of members of the Chicago Section of the American Welding Society attended this interesting lecture, a general invitation to the Chicago Section having been extended by the Western Society of Engineers.

Pacific Coast Steel Men Meet in Conference

Over two hundred delegates were in attendance at the annual three-day conference of the California Iron, Steel and Allied Industries convention held in Santa Barbara, Feb. 10, 11 and 12. This organization is a branch of the California State Chamber of Commerce, and represents over 250 executives of the iron and steel industry from all over the state, who meet annually to co-operate in the promotion of their industries in that state.

Action of the steel, iron and allied industries to bring a just proportion of shipbuilding to the Pacific Coast was outlined in an address by Chairman R. M. Alvord, of San Francisco. He said that the California State Chamber of Commerce, of which the association of steel, iron and allied industries is a branch, had joined with the West in giving united support to proposed Federal legislation that will give Pacific Coast shipyards fair opportunity to secure a just proportion of American shipbuilding on the basis of national defense and sound national economic progress.

An address was delivered on the last day of the convention by Charles F. Abbott, director of the Institute of Steel Construction, New York. Mr. Abbott's address was the outstanding feature of the day, his subject being: "Steel—Its Principal Problem."

Del Monte was selected as the next convention city, and the 1933 conference dates were set for Feb. 9, 10, and 11. Chairman Alvord, Vice-Chairman Emanuel Jungquist, of Los Angeles, and Secretary C. H. Knight, of San Francisco were re-elected for the coming year.

Langmuir Honored by $10,000 Award

Irving Langmuir, research chemist and physicist, and associate director of the Research Laboratories of the General Electric Co., at Schenectady, N. Y., this year's winner of the *Popular Science Monthly* Annual Award of $10,000 for notable scientific achievement.

Announcement to that effect was made recently by Raymond J. Brown, editor of *Popular Science Monthly*, who stated Dr. Langmuir was singled out for the distinction from hundreds of candidates in recognition of his numerous contributions to pure and applied science, among which his inventions of the nitrogen-filled incandescent electric light bulb and the atomic welding arc are conspicuous. The award, together with a gold medal commemorating it, was presented to Dr. Langmuir on February 29, in New York City.

The *Popular Science Monthly* Award, was established two years ago for the double purpose of honoring Americans who have done notable scientific work and of stimulating the public mind to a greater appreciation of the values of scientific investigation. The first winners were Dr. George H. Whipple, of the University of Rochester, and Dr. George R. Minot, of Harvard University, who received the award jointly last year for their discovery and development of a cure for pernicious anemia.

California Welding Plant Has New All-Welded Home

The Vogan Iron Works, of Pasadena, Calif., specialists in welding and ornamental iron work, whose former location was at 30 East Bellevue Drive, recently completed the erection of a new building for their plant. They have recently completed moving their equipment to the new plant which is situated at 1000 South Broadway, in Pasadena. The new building is of all-electric welded structural steel construction. It is 40 feet wide by about 120 feet long and has a clearance under the roof trusses of about 8½ feet. The trusses (40 feet in length) are of 2½-in. angle iron for the top, and 2-in. angle iron for the bottom pieces. Bracing members, or supports, are of ⅝-in. rods. Four-inch "H" columns form the main supports for the trusses. One and one-half-inch angle iron attached to welded clips form the side purlins for fastening the sheet metal siding.

This New 40x120-Foot Building Is Completely Welded.

The Vogan Iron Works is under the management of the joint partnership of D. E. McCoy and W. H. Penwarden. General welding contracting of all kinds, together with high class ornamental iron work is featured in the plant.

New Location for Burdett in Atlanta

The Burdett Oxygen Company, of Atlanta, Ga., is now settled in a new location at the corner of Techwood Drive and Simpson Street. The location is near the principal automobile center and takes care of both the general office and the warehouse space. Three large loading gates are provided on a concrete platform so that trucks can have easy access for rapid loading of tanks. The offices are large and airy with a convenient stock room arrangement where customers can select their requirements of welding equipment and supplies. In the same building there is an equipment repair department in charge of a well-trained operator where all makes of oxy-acetylene equipment are repaired.

The New Office and Warehouse of the Burdett Co. in Atlanta.

"Gas Welding in Production" is Chicago Section Topic

At a meeting of the American Welding Society, Chicago Section, which was held Friday evening, March 4th, the general subject was "Gas Welding in Production." The first paper was presented by H. O. T. Ridlon, of the Barrett Hardware Company, Joilet, Ill., on the subject of "Production Welding With the Oxy-Acetylene Torch." This included an interesting discussion on the importance of setting up adequate facilities when the torch is used in production work, the necessity for having equipment of the proper capacity and design for the work to be done, and the relation between the proper design of jigs and fixtures and efficiency of operation. A number of lantern slides were used to illustrate the various points brought out in the paper.

This paper was followed by a talk on the Lindeweld process given by J. W. Haygood, of the Linde Air Products Com-

pany. Mr. Haygood's talk was supplemented by a motion picture showing the Lindeweld process in detail, and an actual demonstration of the process making a butt weld on 10-inch standard pipe.

During the meeting nearly thirty welded coupons were turned in for X-ray examination. This X-ray inspection is to be made during the month of March, and a complete report and discussion of all of the coupons will constitute the program for the April meeting of the Chicago Section.

New Yorkers Discuss Structural Steel Report

The findings of the Structural Steel Welding Committee, their significance and application, were the subject of the Structural Welding Symposium presented at the joint meeting of the New York metropolitan sections of the American Welding Society and the American Society of Civil Engineers, held on February 9. More than four hundred and fifty were gathered in the auditorium of the Engineering Societies Building to hear the addresses by members of the committee.

"Significance and Importance of the Report," a concise address by L. S. Moisseiff, chairman, Structural Steel Welding Committee, opened the very interesting program. This was followed by "Aims of the Investigation," by F. T. Llewellyn, past president of the A. W. S. and representative of the A. S. C. E., setting forth what did and what did not constitute the objectives and the scope of the investigation, which covered five years and represented the co-operation of three rolling mills, 39 fabricating shops, 61 welders, 18 inspectors and 24 testing laboratories.

"Results of the Tests and Recommendations of the Committee," an illustrated presentation by H. M. Priest, vice-chairman of the committee and chairman A. W. S. New York section, detailed the tests and the results on which the findings were based.

The meeting concluded with "Practical Applications to Steel Structures," by F. P. McKibben, consulting engineer and senior vice-president of the American Welding Society: this presentation was illustrated with a number of interesting views of welding on bridges, elevated structures, buildings and other structures, and portrayed the possibilities in the application of the findings to steel structures in general.

A Chemical Center for Chicago

The first step in the establishment of a great chemical center in Chicago was taken Saturday, January 30, when officers of the Chicago Section of the American Chemical Society signed a 5-year renewable lease for facilities in the Midland building, one of Chicago's modern office structures, 22 stories high, centrally located.

This lease gives members of the Chicago Section of the American Chemical Society the use of the Midland Club quarters for meetings.

At the same time the members of the Chicago Chemists Club took over club quarters on one floor of the building.

The Chemists Club lease gives members the right to use the Midland Club facilities at all times, as well as their own. The Chemists Club will be able to furnish regular club accommodations, including dining service and sleeping quarters.

Several chemical companies now have their Chicago quarters in the building and efforts are being made to rent space to other companies allied with the chemical industries, inasmuch as the chemical atmosphere prevailing makes the building particularly suitable for such tenants. Change of name of the building to "The Chemical Center," is contemplated.

Societies Hold Joint Meeting On Weld Testing

Commercial Weld Testing was the subject of a joint meeting of the New York metropolitan members of the American Society for Testing Materials, and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers, held the evening of February 18th in the auditorium of the Engineering Societies Building, New York. Co-operating organizations were the New York section of the American Welding Society and also the Institute of Metals Division of American Institute of Mining Engineers and the New York and New Jersey Chapters of American Society of Steel Treaters. Among other features the program provided the actual demonstration in a commercial manner of both destructive and non-destructive tests similar to the demonstrations included in the program of the International Acetylene Association at its convention in Chicago last November. Destructive tests included visual examination; hammer and anvil nick-break test; free bend test for ductility, and tension test. Non-destructive tests included hardness tests (Brinell test and Rockwell test); specific gravity, stethoscope test, invisible ray tests (X-Ray test, Gamma-Ray test); compression and drift tests (Drift test, Crush test), and Hydrostatic tests. Presentations were made by F. O. Clements, technical director, General Motors Corp. Research Laboratories; F. H. Moore, Research Professor of Engineering Materials University of Illinois; A. B. Kinzell, Chief Metallurgist and W. B. Miller, Welding Engineer, Union Carbide and Carbon Research Laboratories, Inc.; John J. Crowe, Engineer in Charge Apparatus, Research and Development Departments, Air Reduction Company.

Lindeweld Process Shown in Motion Pictures

The technique of the Lindeweld process and its application in the construction of a 20-in. natural gas line are shown in full detail in a motion picture, "New Lindeweld Process for Pipe Line Construction," prepared and distributed by The Linde Air Products Co., 30 E. 42nd St., New York, N. Y.

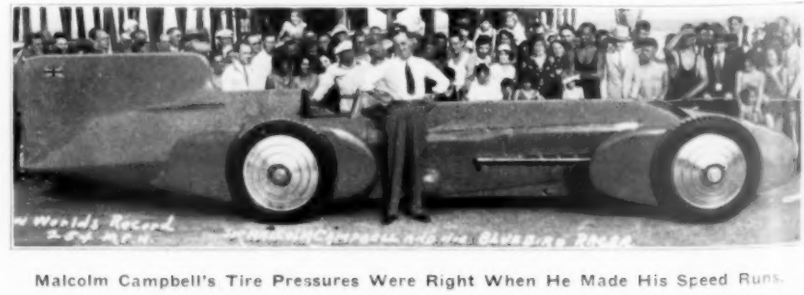
The film comprises two reels, the first of which illustrates the technique of the Lindeweld process. Remarkable close-up views show the action of the flame on the metal and the flow of the weld metal in even greater detail than is visible through welders' goggles. The second reel shows the application of the process in the field in pipe line construction.

Like other Linde motion pictures, this new film is available for showing before Engineering and Technical Societies, Engineering Colleges, Trade and Vocational Schools, Foremen's Clubs, and other technical and industrial groups. Films are loaned free of charge and are available both in 16 mm. and 35 mm. sizes. Since they are of the safety, non-flammable type, they may be shown anywhere without restriction. Inquiries may be addressed to the nearest District Office of The Linde Air Products Co.

Speed King Gets Tire Service from Oxygen Company

It will be recalled that when Malcolm Campbell made his recent runs at Daytona Beach, he succeeded in again shattering the world's automobile speed records, traveling 267 miles per hour with the wind and 241 miles per hour against the wind.

The automobile, named the Bluebird, is said to use a special dynamically balanced set of tires made especially for the purpose, and in these tremendous speed efforts every item counts in keeping the machine properly balanced. It was desired to have a means of inflating the tires so that they could be absolutely sure that each tire would have exactly the same pressure, 160 pounds per square inch. For this purpose, the Burdett Oxygen Company at Atlanta, Ga., furnished, through their agents, the Halifax Machine Works at Daytona Beach, Fla., ten tanks of compressed air to be used for inflating the tires. Apparently the results secured were entirely satisfactory.



Malcolm Campbell's Tire Pressures Were Right When He Made His Speed Runs.

Papers Announced for A. W. S. Annual Meeting

Although the complete program of the annual spring meeting of the American Welding Society, which will be held in New York during the week of April 25th, is not wholly complete, some good progress has been made by the Meeting and Paper Committee in securing speakers of outstanding ability for the technical sessions. According to an announcement in the February issue of the *Journal of the American Welding Society*, the following papers have already been definitely arranged:

Welding in the Construction of U. S. S. New Orleans, by Captain Gawne, U. S. N.

Experimental Determination of Stresses in Fillet Welds, by L. C. Bibber, Bureau of Construction and Repair, Navy Dept.

Study of Transformation of Fusion Welds, by E. R. Hensel and E. I. Larsen, Westinghouse Electric & Manufacturing Co.

Welded Barge Construction, by Gordon G. Holbrook, Federal Shipbuilding & Dry Dock Co.

Cause and Cure of Intercrystalline Corrosion in Austinitic Steels, by John A. Mathews, Director of Research, Crucible Steel Co. of America.

Arc, Gas and Resistance Welding of Pressure Vessels, by H. L. R. Whitney, M. W. Kellogg Co.

Modern Spot and Relief Welding, by P. W. Fassler, Fisher Body Corp.

Symposium on Ductility in Welds—Papers by H. F. Moore, University of Illinois.

C. H. Jennings, Westinghouse Electric & Manufacturing Co.

E. Chapman, Lukenweld, Inc.

C. J. Holslag, Electric Arc Cutting & Welding Co.

C. L. Waddell, Worthington Pump & Machinery Corp.

D. Rosenthal, University of Brussels.

T. W. Greene, Linde Air Products Co.

British Compile Rules for Arc Welding on Ships

Provisional rules for electric arc welding in British ships have been compiled by the British Corporation Register of Shipping and Aircraft, Glasgow. In these rules it is remarked that as uniform results are inconsistent with variations in electrodes, electric current, or in the rate at which welding is deposited, it is essential that all welding shall accord exactly with the conditions which governed the acceptance tests and are expressed in the rules. Other methods which are uniformly applied may be accepted subject to satisfactory acceptance test results which prove them to be at least as efficient.

Welders are to be trained operators in the class of work on which they are engaged, and care is to be taken that every weld is made in the manner approved at the acceptance tests. The surveyors are to check the methods of the operators from time to time, as the work proceeds; they are to satisfy themselves that all the approved conditions are being uniformly observed, and that each operator maintains the full approved run from each electrode in every weld. The surveyors may call for fresh acceptance tests if dissatisfied with the appearance or quality of the work. Such tests are to be made by the operator whose work is in question and under the conditions which governed that work.

Welding Contractor Stands Pat Against Doubters

C. L. Meinholdt, of the Topeka Arc Welding Company, Topeka, Kan., had to do some talking a few weeks ago to prove that big welding jobs are not impossible. Shortly after the first of the year, a cast iron boiler was broken in one of the schools by turning cold water into it. There was a 16 ft. 8 in. break in three sections. After he had welded it, there were a number of doubters who seemed to think that it was too big a job to weld, so a newspaper reporter dropped in to make inquiry from "Shorty" Meinholdt himself. "Shorty" admitted that it was a very large break but nevertheless proved to him that it had been done, and furthermore, that the job was standing up successfully. It certainly is good advertising for a welder when he gets so much good publicity for doing something which seems to be in the impossible class.

Ironsmiths and Welders to Meet at South Bend

The 33rd Annual Convention of Indiana Ironsmiths and Welders Association will be held at the La Salle Hotel, South Bend, Ind., on April 5th and 6th. After registration of delegates, members and supply salesmen, the convention will be called to order and short talks will be given by representatives of wholesale houses and manufacturers of iron working and welding equipment, with discussion by the members in attendance. There will be demonstrations of oxy-acetylene and electric arc welding and exhibits of equipment after each session of the convention, and at the various sessions there will be opportunities for discussion of welding problems in open meeting. An election of officers for the coming year will take place at the end of the second day.

Knowles Electrolytic Hydrogen Cell Improved

An important improvement in the well-known Knowles electrolytic hydrogen generators has recently been announced by The Linde Air Products Co., New York, who are sole agents for the Knowles generators in the United States and Canada. After considerable research and practical experimentation a new double-depth generator has been placed on the market. These new generators are now being sold in addition to the standard generators.

In the double-depth generator a number of important advantages have been obtained. The capacity is 50 per cent greater than the standard generator while the space required to house a producing plant has been decreased one-third. The electrode area has been doubled while the electrode ampere density has been decreased 33⅓ per cent with a resulting power consumption decrease of more than 5 per cent or taking these figures and translating them into terms of total plant investment it is found that there is a reduction of approximately 15 per cent when the new Knowles double-depth generators are used. Another important feature is the method by which the hydrogen produced is cleaned by means of gas washing tanks. Each row of generators is equipped with a set of these tanks which wash out any caustic soda vapor which might be entrained in the gases and in conjunction with the automatic water feed equipment returns it in proper proportion to the generators; thus a uniformity of electrolyte solution and consequently electrical efficiency is maintained.

Both the Knowles double-depth and the Knowles standard electrolytic hydrogen generators are now being made in 36 different sizes and capacities ranging from 166 to 15,000 amperes with productions of 2.6 cu. ft. to 243 cu. ft. per hour for each generator.

First Welded Bridges Completed in Britain

The London & North Eastern Railway, the second largest railroad system in the United Kingdom, has now in service on its lines three bridges which are unique in the British Isles inasmuch as these steel structures are welded together throughout to form one solid unit. In addition to these bridges, constructed by the railroad's own staff of electric welding experts, the company has three welded bridges in course of construction, while invitations have just been sent out to a number of steelwork contractors to tender for a fourth. The success of these structures may induce the other three large British railroad systems to adopt welding in their bridge construction programs.

Book Review

"Economic Attitudes in Industry" are discussed in Circular 26 of the Ohio State University Engineering Experiment Station. Fifteen questions having to do with fundamental problems and policies in the industries were put to 400 industrial leaders, and in addition to 45 economists. The answers were analyzed and commented on by F. C. Caldwell, professor of electrical engineering; C. A. Norman, professor of machine design; and John Younger, professor of industrial engineering.

There was noted among those answering a distinct desire to rationalize industrial processes and the feeling was preponderant that by such rationalization a fair degree of well-being and comfort can be secured for all citizens. As to methods and agencies of rationalization there was, however, a great diversity of opinions. Business leaders in general do not favor much government interference, except perhaps in national emergencies, but among econ-

omists there is a large group who believe that only through government guidance, and in some cases even government ownership, can real rationalization be brought about.

On the other hand such things as old-age pensions, shortening of the working day and working week, and even unemployment insurance find a surprisingly widespread support even among industrial leaders, and there seems to be little hesitation to admit that labor organizations could furnish distinct aid in rationalization.

There is almost unanimous emphasis on the need for more cultural training and a wider social outlook among industrial executives, and numerous suggestions are given as to topics of study which would help engineering students to gain these qualifications.

The circular can be obtained free of charge by addressing the Director, Engineering Experiment Station, the Ohio State University, Columbus.

An Investigation of Pressure Welding

Technical Bulletin No. 451 of the American Institute of Mining and Metallurgical Engineers, 29 W. 39th Street, New York City, contains a discussion of pressure welding of low carbon steels with theoretical considerations on the mechanism of such welding which was presented at the New York meeting of the Institute last month by C. R. Austin, of the Westinghouse Research Laboratories, and W. S. Jeffries, of the Research Laboratories of the National Tube Company. The paper describes an investigation on the pressure welding of low carbon steels. The work necessitated a reproducible mechanical means of making the weld and also a test that would indicate the nature and completeness of the union. An apparatus including a high temperature furnace was devised for making the welds, and the ordinary tensile pulling test in correlation with macroscopic and microscopic observations was used as a means of examining the result. The conclusions pointed to the quality of the welds being influenced by film interference, pressure, oxygen embrittlement, and a tendency to contain a preferred grain boundary orientation. The oxide film is indicated as the most serious obstacle to the making of a good weld by pressure.

New Literature on GE Arc Welders

Bulletin No. GEA-1543 recently issued by the General Electric Company, Schenectady, N. Y., furnishes four pages of description and illustration of the GE line of gas engine driven arc welders in capacities from 200 to 600 amperes. These welders are said to be capable of supplying rated current at high voltages without overloading the generator. Mechanically, the sets are designed for heavy duty and hard service. Standard equipment includes a weather-proof sheet metal canopy with removable sides which can be locked in place. Steel tires, solid rubber tires or pneumatic tires can be furnished. A complete description of the design features of the arc welding generator was published in the February, 1932, issue of the *General Electric Review*. This article details the requirements of the welding generator which the designers had in mind when they started work on a new type of machine and includes much information regarding tests which have been made to show its operating characteristics.

Booklet Cites Case Histories Showing How Pipe Welding Saves

The Bastian-Blessing Co., 240-258 E. Ontario St., Chicago, has issued an interesting new booklet to show the economies of welded piping. The title "Proof Plenty" is lived up to by the text, which shows beyond doubt that welding pipe offers better results at a lower cost than any other method. Case histories show exactly how well known organizations proceeded to overcome specific problems; these are condensed and illustrated so as to be of great value to the welding shop designer, foreman or welder.

Starting with the question, "Why weld pipe?" the contents show reasons for and against, and conclude that welding is the superior method. Other questions are concerned with decreased weight, increased efficiency and decreased cost. Leak proofing and lowered alteration costs are also covered. Examples are given, authorities are quoted and illustrations are used to make it clear that even the apparently intricate job of welding is simple, rapid and economical. Copies of the booklet are available to anyone interested in pipe welding.

The Alabama Conference Set for May

The program of the First Southwide Welding Conference, which is to be held at Alabama Polytechnic Institute, Auburn, Ala., during the last week in May, will include technical papers by twenty-four engineers from all parts of the United States, covering all phases of the fusion welding processes and their up-to-date application. A large number of practical demonstrations and elaborate exhibits of equipment have already been arranged according to Prof. Dan T. Jones, who is in charge of the arrangements. Newspaper announcements are already paving the way for the event by preliminary announcements in which users of welding equipment in all of the southern states are invited to attend.

Langdon Hall, Where General Meetings Will Be Held.

The importance of this conference does not lie altogether in the fact that this is the first one of its kind to be held in that district. It is further important to note that there has been a rapid development in industry in the state of Alabama in recent years. The state used to ship its raw materials away and use the money received for them to buy things which could not be produced within the state. Now Alabama is engaged in developing industry along with agriculture, with the expectation of shipping a large volume of finished products in the future, rather than simply the raw materials. The state has large resources in coal, iron, timber and power. It is already holding fourth place in cotton manufacture. The Alabama Polytechnic Institute is playing an important part in this industrial development. There has been a steady increase in the activities of the engineering departments, including an engineering experiment station, which was established a couple of years ago. The school is one of the largest engineering schools in the South, and its graduates are to be found in all of the important engineering industries in the southern states. The progressive spirit of the institution is shown in its decison to start this movement at a time when the industries are growing, knowing that their growth can be accelerated if they are well informed on modern welding processes and welding methods.

Linde Announces Purox Tip Adaptor

The Linde Air Products Co., 30 E. 42nd St., New York, has recently added to its line of Purox welding apparatus the Purox 11-to-00 tip adaptor which can be used to increase the range of usefulness of the Purox No. 11 welding torch.

By means of the new device it is now possible to use the stems and tips of the Purox No. 00-D aircraft welding torch and the stems and tips of the Purox No. 00 welding and lead burning torch on the Purox No. 11 welding torch, thus enabling a welder who has only an occasional light welding job to use the correct welding tips for this small work. This eliminates the expense of investing in a complete lighting welding outfit merely for the sake of a few such jobs.

Lincoln Makes Electrode For Welding Aluminum

The Lincoln Electric Co., Cleveland, Ohio, announces a new electrode for welding aluminum which will be known as "Aluminweld." The new electrode is a 5 per cent silicon aluminum alloy and can be used for welding sheet or cast aluminum. It is designed for either metalic or carbon arc welding.

It is provided with a coating which prevents excessive oxidation and will dissolve any aluminum oxide that might be formed. The manufacturers claim that the coating assists in giving a very smooth operating arc which is particularly essential in welding aluminum.

The resulting weld is said to be very dense without porosity and possesses high tensile strength. The weld can

also be polished satisfactorily with practically no discoloration.

In its use a short arc of approximately 20 volts should be held with the coating practically in contact with the work. The current to be used will vary with the thickness of sheet or material to be welded but the following table gives a good idea of the proper currents.

Size Electrode	Current Range	Average
5/32 in.	35- 45 amperes	40 amperes
1/4 in.	55- 80 amperes	70 amperes
5/16 in.	100-150 amperes	125 amperes

Use 5/32-in. for sheet up to 14 gauge, 1/4-in. from 14 gauge to 1/8-in. and 5/16-in. for sheet over 1/8-in. thickness. Sheets of over 5/16-in. thickness should have the edges beveled if welded from one side only. In all cases when used with metallic arc process reversed polarity is used. Aluminweld is produced in four sizes, 3/32-in., 1/8-in., 3/32-in., and 5/16-in. in 14 inch lengths.

Preheater for Castings Aids Welding

The Crawford Oven Company, New Haven, Conn., has developed the Crawford welding preheater for preheating castings preparatory to welding. The equipment is built in two sections, a burner section below and a heating chamber above. In the lower section are located a series of gas burners. The upper section is built

This Preheater Permits Access to Work Without Danger of Drafts.

with sliding doors at the front, back, top and ends. Through these sliding doors any part of the work can be reached by the welder from any position, using a minimum opening and eliminating cold drafts on the casting. The oven is constructed of structural iron and sheet steel with the bottom, top and sides carefully insulated. Although the top is composed of sliding doors, it is so arranged that the entire top is hinged and can be opened in order to load and unload the pieces. The weight of the casting is held above the heating chamber on cast iron grate bars, over which refractory materials are distributed. There is a metal plate on which the casting rests so that it can be easily moved about during welding. During the heating up period, all doors remain closed, and when the casting has reached the proper temperature the operator welds through the small sliding door located nearest to the brake. The casting can be left in the preheater for slow cooling, if desired.

These preheating units can be made in any desired size. The standard size has a heating section 5 ft. long, 3 ft. wide and 2 ft. high.

"HardKote" Welding Rod— A New Hard Surfacing Material

A hard surfacing welding rod called "HardKote" has been developed by the Bonney-Floyd Company, Columbus, Ohio, which can be applied by either gas or arc welding. It is said to be composed of several alloys, all of which have great affinity for iron and steel. The manufacturers also claim that its low melting temperature and alloying tendency give it a high degree of weldability and ease of application. They also state that it has the toughnesses of many materials which are much less resistant to abrasive wear and consequently has the ability to stand shocks without cracking or chipping. It is stated that smoother deposits can be obtained with the gas process, while faster application is possible with the arc. In either case a clean surface is necessary to produce good welds. No flux is required, but preheating is recommended whenever it is possible except when the base metal is manganese steel. When the gas process is used, a low pressure flame with a slight excess of acetylene is recommended and the base metal is heated only to the sweating temperature. No puddling is necessary. When using the electric arc, the "HardKote" electrode is made positive and a voltage of 40 to 70 with 200 to 350 amperes is recommended. The use of a short arc is also recommended to insure better penetration and freedom from spattering. Descriptive circulars and instruction sheets are available from the manufacturers.

Special Welders for Brake Shoes

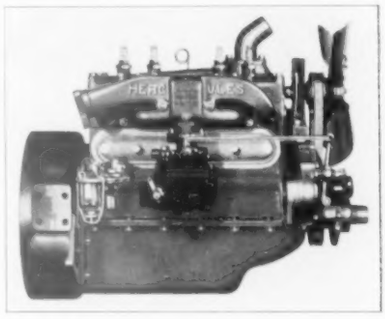
A bulletin of the Thomson-Gibb Electric Welding Co., Lynn, Mass., illustrates and describes resistance welders made for manufacturers of brake shoes. One machine makes 10 projection welds in welding the rim to the web, the machine averaging 600 shoes per hour. A second machine joins 4 reinforcements to the shoe after the rim has been welded to the web. These reinforcements are also joined by projection welds. The capacity of this second machines is 1,000 shoes per hour.

Hercules Has New Small Series Engine

The Hercules Motors Corp. of Canton, Ohio, in announcing the IX series engines and power units has added the following models to their present line of heavy duty four and six cylinder engines, thus giving a complete range of sizes of from 9 to 175 horsepower.

Model	Bore	Stroke	Displacement
IXA	3	4	113.1
IXB	3 1/4	4	132.7

The two models are identical in general design and the majority of the parts are inter-changeable; the only difference being in the bore sizes and the parts affected thereby. The maximum torque of the IXA is 76 pounds developed at from 1400 to 2400 r.p.m. and on the IXB is 90 pounds developed from 1400 to 2300 r.p.m. Both models peak at 3200 r.p.m., the IXA developing 39½ horsepower, the IXB 46½ horsepower at this speed.

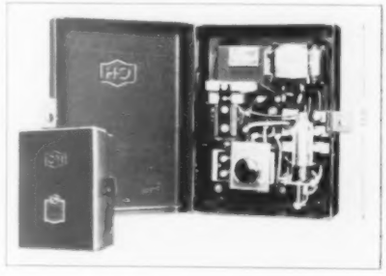


Hercules, New IX Series Gasoline Engine.

To meet present-day operating conditions calling for sustained high speed, special consideration has been given to valve cooling. The engines and power units are equipped as standard with a No. 5 standard S. A. E. bellhousing, but the No. 4 and No. 6 can be supplied upon request. Standard practice includes thermo-syphon cooling, but water pumps are available if specified. Either down-draft or up-draft manifolds are optional.

New Tube Timing Control For Welding Service

Cutler-Hammer, Inc., Milwaukee, Wis., manufacturers of electric control equipment, announce a new device which promises wide use in industry. The product is a new timing device for



New Control Device for Accurate Timing in Resistance Welding Operations.

spot, projection and other forms of resistance welders. The manufacturer claims extremely accurate timing control of the welding operation. Use of an electronic tube, it is further stated, makes possible an accuracy of better than a fraction of a second and the device has an adjustable range up to 16 seconds.

This new Tube Timing Welder Control is said to eliminate all guesswork on the operator's part—enabling unskilled operators to produce successful welds and to practically eliminate rejects and throw-outs. The timing is adjusted by a knob inside the enclosing case. The control unit requires a very

small mounting space and operates on 110 to 550 volts A. C., 25 to 60 cycles. Vibration, severe or intermittent service will not affect the accuracy of this control, the manufacturer asserts.

New Engine Primer Uses Acetylene

A new gasoline engine primer which utilizes acetylene has recently been announced by The Linde Air Products Co., 30 East 42nd St., New York City. The P-O-L primer by introducing highly combustible acetylene into the cylinders

The P-O-L Gas Engine Primer.

of internal combustion engines greatly facilitates starting particularly in cold weather. It is a simple and easily installed device consisting of a special stem type brass primer valve, a Prest-O-lite pressure regulator and 10 ft. of ¼-in. brass tubing with compression unions. The valve is mounted on the intake manifold of the engine and operated by a wire pull which leads from the valve lever through the dash, if the vehicle has a self-starter, or through the radiator if hand-cranking is used.

New Whelite Welding Rods for Non-Ferrous Metals

Several new welding rods for work on non-ferrous metals have recently been developed by Whelite Distributors, Los Angeles, Cal. One of these is a cast copper welding rod containing 99.25 per cent copper, which the manufacturers state can be used with the electric arc or oxy-acetylene torch without any flux. A cast aluminum welding rod has also been produced which can be applied with the oxy-acetylene torch without the necessity of using a flux. Development work is now under way on other alloy rods such as bronze and stainless steel.

Whelite is the name under which processes developed by George Wheeler are now known. Mr. Wheeler has devoted many years to research in the structure of steel and in the crystal structure of minerals and metals. The processes developed by him have been used to improve castings in bronze, cast iron and semi-steel.

News of the Industry

Daniel A. Lee has severed his connection with the General Welding & Equipment Co., of Boston, with whom he had been associated for the past eighteen years. Mr. Lee is now the president of the Gas-Weld Equipment Co., Inc., 26 Cambria Street, Boston, Mass.

The Gas-Weld Equipment Co. are carrying a complete line of oxy-acetylene equipment and supplies, and its repair department is in a position to render immediate service.

Joseph C. Paulus & Co., 2507-11 Potter Street, Philadelphia, Pa., have just issued a folder describing in detail the "Secator" portable, motor-driven, hand cutting machine for precision cutting of steel shapes.

The Soule Steel Company, of Los Angeles, Cal., recently completed the construction of three all-electric welded structural steel buildings for the Pacific Freight Lines. These buildings, which are situated at 2500 Alameda Boulevard, include a large warehouse, garage and general repair shop, and a main office building.

John F. Connor, owner of Connor's Welding Works, San Diego, Cal., recently moved back to his old stand at State and "G" Streets from 14th Street and Broadway where he moved his equipment over a year ago. Mr. Connor features electric and acetylene welding work of all kinds, but makes a specialty of aluminum welding.

The Peters Welding Works, of San Diego, Cal., have been awarded a contract for the erection of an all-welded structural steel service station consisting of a garage for repair work, storage garage for several cars, and the service station proper. The construction of these buildings will be practically all by electric arc process. The work is being done for Walter Church, owner.

Frank M. Drane, of the Drane Tank Company, manufacturers of welded storage tanks in the Mid-Continental oil fields, recently spent ten days in Tulsa, Okla., on business. Much of this company's output of welded tanks during the past year has gone into the East Texas field.

W. S. Pattison, of the Arrowhead Iron Works, Kansas City, Mo., recently made a business trip to Tulsa, Okla. This company maintains a well-equipped welding department for both acteylene and electric arc work.

The Burke Electric Company, of Erie, Pa., announce that beginning March 1, 1932, distribution of their complete lines in the Chicago district will be handled by Albert J. Walz as distributor. Mr. Walz will be located at Room 200, 205 West Wacker Drive, Chicago, Ill., telephone Franklin 4400. The Burke Electric Company also announces that Mr. P. J. Burrill and Mr. J. L. Vergillio are likewise general distributors for northern Ohio and are located at 942 Prospect Avenue, Cleveland, Ohio, telephone Cherry 3235.

Joseph T. Ryerson & Son, Inc., have announced that the management of their St. Louis plant has been taken over by Mr. Harold B. Ressler, vice-president at Chicago. Mr. Ressler, who was formerly the St. Louis plant manager for fifteen years, will be in direct contact with the St. Louis organization, making regular visits to the plant and St. Louis territory.

Mr. G. Fred Sherman, formerly assistant sales manager of Tube-Turns, Inc., Louisville, Ky., was recently appointed manager of sales of the Forged Fittings Division of Bonney Forge & Tool Works. Mr. Sherman will supervise the sales and sales promotion of Bonney Weldolets, Thredolets and Welding Flanges. He will be located at the general offices of the Bonney organization at Allentown, Pa. Mr. Ben Bush and Mr. Howard F. Grimes were recently appointed to the sales staff of the Bonney Forged Fittings Division. Mr. Bush will have charge of the selling in the New York and Pennsylvania district. Mr. Grimes will pursue his duties over the Middle Western section of the country.

Tests of demolition bombs made of welded steel plate, recently made by the United States Army at the Aberdeen Proving Grounds in Maryland, showed that both longitudinal and circumferential welds on all bombs withstood the standard tests. The bombs were made by the A. O. Smith Corp., Milwaukee, automatic arc welding being used.

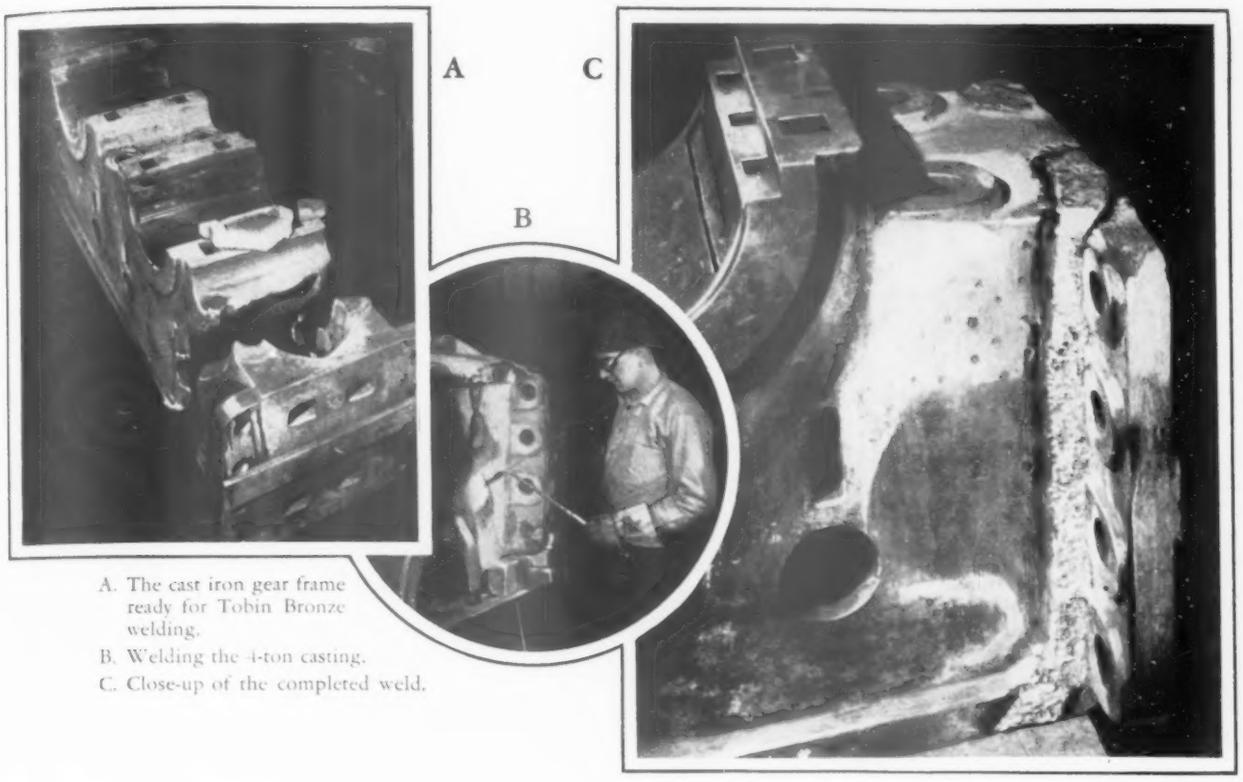
W. A. Spraragen, Secretary of the American Bureau of Welding, Research Division of the American Welding Society, has contributed a series of two articles on "The Present Use of Welding in the Pressure Vessel Field" to recent issues of the *Iron Age*.

The headquarters of the American Solder & Flux Co. have moved from 280 North 16th St., to Wayne and Berkley Sts., Philadelphia, Pa.

At a meeting of the Steel Founders Assn., held in the Stevens Hotel, Chicago, January 21, 1932, J. G. Ritter, Welding and Foundry Engineer for the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., presented a paper on the "Use of Castings in Welded Structures."

Koro Corporation, Bellwood, Ill., announce the appointment of C. H. Parker, formerly with the Westinghouse Electric & Mfg. Co., as sales representative in northern Chicago, Illinois and Wisconsin. Ed Waters, formerly with Warner Engineering Co., New York office, has been appointed as sales representative in the southern part of Chicago and the state of Indiana. Koro Corporation has been appointed distributor for Westinghouse arc welding equipment and welding electrodes for the states of Indiana, Wisconsin, Illinois, southwest Michigan and eastern Iowa.

J. M. Mathews, Secretary and Sales Manager of the Harris Calorific Company is now on an extended tour of the southwest, which will carry him far into Mexico and through the states of Texas and California. This is an annual jaunt which requires a couple of months and enables Mr. Mathews to demonstrate to Harris distributors new apparatus put out by the company.



A. The cast iron gear frame ready for Tobin Bronze welding.
B. Welding the 4-ton casting.
C. Close-up of the completed weld.

Four 4-ton castings repair-welded with TOBIN BRONZE . . . for $300

FOUR cast iron gear frames broke when the foundation settled under a continuous bar mill. As new castings would have cost from $10,000 to $12,000, repair-welding with Tobin Bronze was decided upon. The job required 300 lbs. of ¼" Tobin Bronze rod. During welding, a slight normalizing heat was played on the inside of the castings. Welds were kept covered with asbestos until completely cooled. The estimated cost of work, including labor and materials, was only $300. The low melting point of Tobin Bronze minimized heating, and effected important savings in time and fuel.

The uniform high quality and unvarying dependability of Anaconda Welding Rods are due to the experience and technical knowledge gained in developing a complete line of Copper-alloy rods for gas and electric welding. Anaconda Welding Rods are available through leading distributors of welding supplies . . . usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. For complete information, ask for Anaconda Publication B-13.

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

For Oxy-Acetylene Welding

Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

For Arc Welding

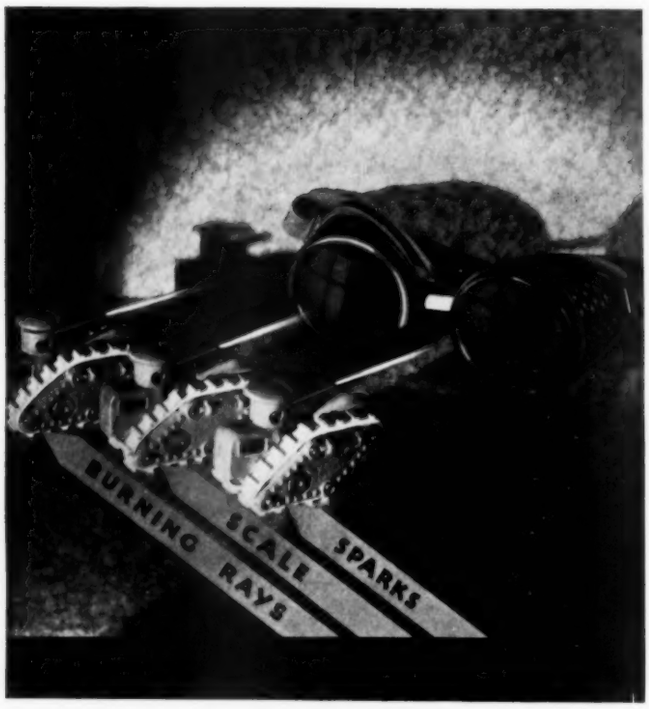
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities

ANACONDA WELDING RODS



'THEY SHALL NOT PASS,

SPARKS, SCALE AND INJURIOUS LIGHT SIMPLY CAN NOT GET BY DURAWELD GOGGLES . . . .

Duraweld fits snugly to eliminate the chance of flying particles or burning rays getting in from the sides. The generous louvers which provide eyecup ventilation are light proof. The eyecup material is tough; does not conduct electricity and is moisture proof. The Noviweld Lenses in Duraweld Goggles are available in shades which protect against *all* injurious light radiations.

If your eyes were exposed to the hazards of welding you would want the protection provided by Duraweld Goggles. Can you do less for your men?

DURAWELD GOGGLES

Patented

J392

★ ★ ★

SAFETY DIVISION—*Branches in All Principal Industrial Centers.*

AMERICAN OPTICAL COMPANY

A. H. Kasishke, of Tulsa, Okla., steel oil rig-building contractor, has acquired the J. A. Werme Steel & Iron Works in Oklahoma City. With a plant in Oklahoma City 600 feet long and 150 feet wide, it is planned (in additon to the manufacture of steel derricks) to begin the manufacture also of steel walking beams, rig irons, steel fronts, etc., all of which will give use a great amount of welding.

The Foster Wheeler Corporation, of Toronto, Canada, has been awarded a contract by the Simrall Refining Corporation, for the construction of an oil refinery in Amherstburg, Ontario. This work, which will require a great deal of welding both by electric and acetylene processes, is scheduled for completion by April 1st. The refinery will be on the Detroit River north of Amherstburg.

G. T. Hoffman recently opened a welding shop at 1403 East Broadway in San Diego, Cal. General repair job welding and brazing will be featured in the new shop which will be operated under the name of the Hoffman Welding & Brazing works. Mr. Hoffman was formerly associated with the Shelley Pipe Company in San Diego.

The monthly meeting of the Cleveland Section, American Welding Society, was held February 17th in the C. E. S. rooms, Cleveland, Ohio. The speakers for the evening were W. T. Rogerson who read a paper on The Welding of Aluminum Using Oxy-Acetylene and Metallic Arc Welding Processes. Following Mr. Rogerson, D. I. Bohn of The Aluminum Company of America gave a talk and told of the progress being made in the Resistance Welding of Aluminum.

The Goodman Electric Machinery Company, 1060 Broad Street, Newark, N. J., has recently issued a bulletin listing for sale a number of used arc welding generators of various makes and capacities.

At the meeting of the Institution of Welding Engineers, London, which was held February 24th, announcements were made of winners of the 1931 Prize Competition, and the winning paper entitled "Welding and Cutting on Railways and Tramways," illustrated by lantern slides, was read.

The American Compressed Gas Company, 701 S. Western Avenue, Chicago, has been organized to market oxygen and acetylene in cylinders. It is reported that welding and cutting equipment and supplies will be handled later. The new concern is under the management of C. W. Steele, who has been connected with the Burdett Oxygen Company of Chicago for a number of years.

Effective February 1st, the Warner Engineering Corporation, Pomona, Cal., manufacturers of Warner electric welders, changed its name to Weco Engineering Corporation. Their address is First and Huntington Streets, Pomona, Cal.

F. L. Stockwell, Dubuque, Iowa, has obtained a lease on the Bristow building and has opened a modern blacksmith and welding shop.

Members of the Tri-City chapter of the American Society for Steel Treating, more than 50 in number were given an insight into latest welding methods at the LeClaire hotel, Moline, Ill., when G. N. Sieger of the P. R. Mallory Co., Indianapolis, Ind., demonstrated uses of Elkonite and Carboloy through a display of welding practices and cutting tools.

The Iron Age recently featured a photograph showing a 285 ft. length of electric welded 8-in. pipe fabricated by the Republic Steel Corporation and formed cold from a single continuous length of plate. The weld was made by the resistance method. It is claimed that this is the longest piece of pipe ever made without circumferential welds.

Brazed Copper Water Tanks

(Continued from page 50)

has been so well made that it can be seen only on close examination.

The head for the tank (Figure 3) is of the same material with a 1⅜-in. flange turned up on it. It is also

Figure 5. Completed Tank Being Tinned.

brazed. A finished section of the joint is shown in Figure 4.

On completion the tank was tested for tightness and then tinned on the inside as assurance that no taste would be imparted to the water.

Announcement has been received that the Austin Company, Cleveland, Ohio, has established a welding division for the production of welded frames, bases and other machine parts; also machinery and factory equipment.

C. L. Jones, formerly connected with the Air Reduction Sales Company, New York City, has been appointed sales manager for Wilson Welder & Metals Company, Inc., North Bergen, N. J.

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

WANTED TO BUY

Oxygen Cylinders—500 oxygen cylinders, recent test, desired. Send full particulars. Address Box 451, The Welding Engineer.

FOR SALE

CRAFTSMASTER: The poor man's torch, $15 with three tips. Jobbers wanted.
Torch Shop & Factory, 1637 E. Vernon Avenue, Los Angeles, California.

ONE DOLLAR
WILL INCREASE YOUR EARNING POWER
by bringing you any one of the following guaranteed
FLUX FORMULAS

Cast Iron—Brazing—Copper—High-speed Steel—Aluminum (good for both the cast and sheet metal)—or all for $4.00. With instructions YOU CAN MAKE YOUR OWN fluxes just as hundreds of the most successful welders are doing today who insist on having their fluxes fresh when they need them for the better job.
R. N. Robbins, 38 Winans St., East Orange, N. J.

POSITIONS WANTED

Engineer—Thoroughly experienced in design, construction and estimating as well as the manufacture of steel products. Licensed professional engineer. Have been successful in sales work. Age, 39. Desires connection in steel fabricating industry where combination of engineering and sales ability is essential. Address Box 453, The Welding Engineer.

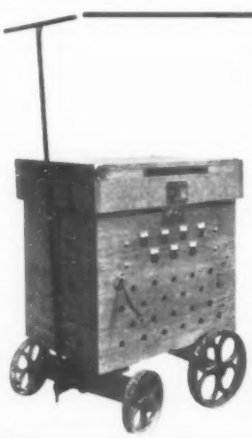
Combination Welder and Brazer—All around experience. Dependable. Will do your welding on a percentage basis. You furnish the equipment and the shop. A chance for you to make added profit. Single. American. Will go anywhere. Address George Francisco, 938 Ellsworth Ave., Columbus, Ohio.

General Oxy-Acetylene Welder. Qualified for any kind of Production Welding of mild steel, sheet work, or brazing metal at any angle including overhead work. "References." Douglas Hicks, Brookville, Ohio.

Practical Welding Engineer—Experience 18 years, including production and custom welding, demonstrating, instructing, apparatus repairing, foremanship, shop management and selling. N.S.T.A. graduate, sober and dependable; with excellent reference. Box 452, The Welding Engineer.

Arc Welder with 8 years' experience at various classes of welding U. S. and Germany. Know drafting. Married, steady worker. O. Wordman, 9372 Goethe, Detroit.

All-Around Combination Welder—Experienced in repair of machinery, tools, boilers and tanks of all descriptions. Know pipe line work—both transportation and power piping. Familiar with shielded arc rods on pipe and plate. Can handle general job shop work in first class manner. Good references. Willing to travel. John Davis, 13 Grove Ave., Oil City, Pa.



Responsible Dealers Wanted

Competitive tests prove that the Smith-Waters Welder can save as much as 50% in welding operating costs. The stable arc assures constant deposition of weld metal. No moving parts. This machine is unconditionally guaranteed for two years.

Write for Proposition Giving Attractive Discount to Live Dealers

David H. Smith & Sons, Inc., 135—51 Street, Brooklyn, N. Y.

SMITH-WATERS WELDER

NATIONAL (TRADEMARK) CARBIDE

Quality Coke
Plus
Quality Limestone
Plus
Engineering Ability
Equal

National Carbide

National Carbide Sales Corporation
Lincoln Building **New York**

SYMON ROCK CRUSHER CONE

faced with
COATED STOODITE
applied with Electric Arc

This crusher cone was faced with twenty-two pounds of flux coated Stoodite. ¶ After crushing 30,000 yards of stone the cone was still in excellent condition. ¶ The operator stated that it would have been worn out at that time if it had not been faced with Stoodite.

Equipment can be made to do double work and even more by the application of Stoody Hard Metals

STOODITE « BORIUM « BOROD « SILFRAM « STOODY SELF HARDENING RODS

STOODY COMPANY Manufacturers of Welding Rod Alloy Steels -:- Equipment Whittier, Calif.